The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

September 1943

Obstetrics . Gynecology

Biliary Surgery . War Injuries

Orthopedics . Gastrointestinal Surgery

Fifty-second Year of Continuous Publication

The American Journal of Surgery, Inc.

49 WEST FORTY-FIFTH STREET · NEW YORK, 19

EDITORIAL BOARD

The American Journal of Surgery

Editor THURSTON SCOTT WELTON, *New York*

ASSOCIATE EDITORS

FRED H. ALBEE, *New York*
CARL BECK, *Chicago*
CLAUDE S. BECK, *Cleveland*
GEORGE R. BRIGHTON, *New York*
MEREDITH F. CAMPBELL, *New York*
JAMES T. CASE, *Chicago*
ISIDORE COHN, *New Orleans*
BRADLEY L. COLEY, *New York*
FREDERICK A. COLLER, *Ann Arbor*
PAUL C. COLONNA, *Philadelphia*
ELLIOTT C. CUTLER, *Boston*
CHARLES A. ELSBERG, *New York*
HERBERT C. FETT, *Brooklyn*
JOHN H. GIBBON, *Philadelphia*
EMIL GOETSCH, *Brooklyn*
CHARLES A. GORDON, *Brooklyn*
DONALD GUTHRIE, *Sayre, Pa.*
ARTHUR E. HERTZLER, *Kansas City*
LOUIS J. HIRSCHMAN, *Detroit*
JAMES M. HITZROT, *New York*
FREDERICK C. HOLDEN, *New York*
EMILE F. HOLMAN, *San Francisco*
JOHN E. JENNINGS, *Brooklyn*
WILLIAM L. KELLER, *Washington*
New York, THOMAS J. KIRWIN
New York, ARTHUR KRIDA
New York, ADRIAN V. S. LAMBERT
New York, MAURICE LENZ
New York, H. H. M. LYLE
New York, JEROME M. LYNCH
New Orleans, URBAN MAES
Newark, HARRISON S. MARTLAND
New Orleans, RUDOLPH MATAS
Detroit, ROY D. MCCLURE
San Francisco, H. C. NAFFZIGER
Baltimore, EMIL NOVAK
Newark, CLARENCE R. O'CROWLEY
Boston, LOUIS E. PHANEUF
New York, EUGENE H. POOL
Rochester, Minn., JAMES T. PRIESTLEY
New York, DOUGLAS QUICK
Brooklyn, NATHANIEL P. RATHBUN
Raleigh, HUBERT A. ROYSTER
Philadelphia, HENRY S. RUTH
St. Louis, M. G. SEELIG
New York, J. BENTLEY SQUIER
New York, H. J. STANDER
Baltimore, GRANT E. WARD
San Francisco, J. HOMER WOOLSEY

The American Journal of Surgery is published monthly by the American Journal of Surgery, Inc., 49 West 45th Street, New York, N. Y. Yearly Subscription, $10.00 U. S. A.; $15.00 Canada; $12.00 Foreign. Single Numbers $2.00; Special Numbers $4.00. Entered as second class matter August 28, 1926, at the Post Office, New York, N. Y., under the act of March 3, 1879. September, 1943—New Series, Volume LXI, No. 3.

THE MARK OF PROGRESS IN SUTURES

Expansion of our manufacturing facilities
has been paralleled by intensification of our research activities.
The rapidity of developments in all scientific fields
is making this work unusually productive.
Therefore, assurance can be given not only for adequate quantities
but for advances in processing
and still further refinements in the products themselves

"THIS ONE THING WE DO—SUTURES"

DAVIS & GECK, INC • BROOKLYN, N. Y.

SUTURES FOR EVERY SURGICAL SITUATION

CLAUSTRO-THERMAL CATGUT • A boilable suture sterilized by the Claustro-Thermal method wherein heat, at temperatures lethal to the most resistant organisms and spores, is applied *after* the tubes are sealed. Its stability permits the tubes to be boiled or autoclaved any number of times without injury to the sutures.

THERMO-FLEX CATGUT • A non-boilable suture, possessing maximum practical flexibility without loss of other equally essential qualities. It is subjected to rigorous heat-sterilization during the manufacturing process. Free from oils, it will not slip at the knot.

ANACAP SILK • This silk, with its unprecedented tensile strength, knot security, and *absolute non-capillarity* under all conditions, marks a definite advance in the field of non-absorbable sutures. It is unaffected by boiling, autoclaving, tissue fluids or germicides.

DERMALON (*processed from nylon*) • These sutures are the product of two and a half years of research and clinical observation in the development of a synthetic monofilament strand. Smoothness, elasticity, and impermeability are characteristics of the basic substance —nylon. Permanence of color, uniformity of size and other qualities essential to satisfactory behavior are assured by D & G processing.

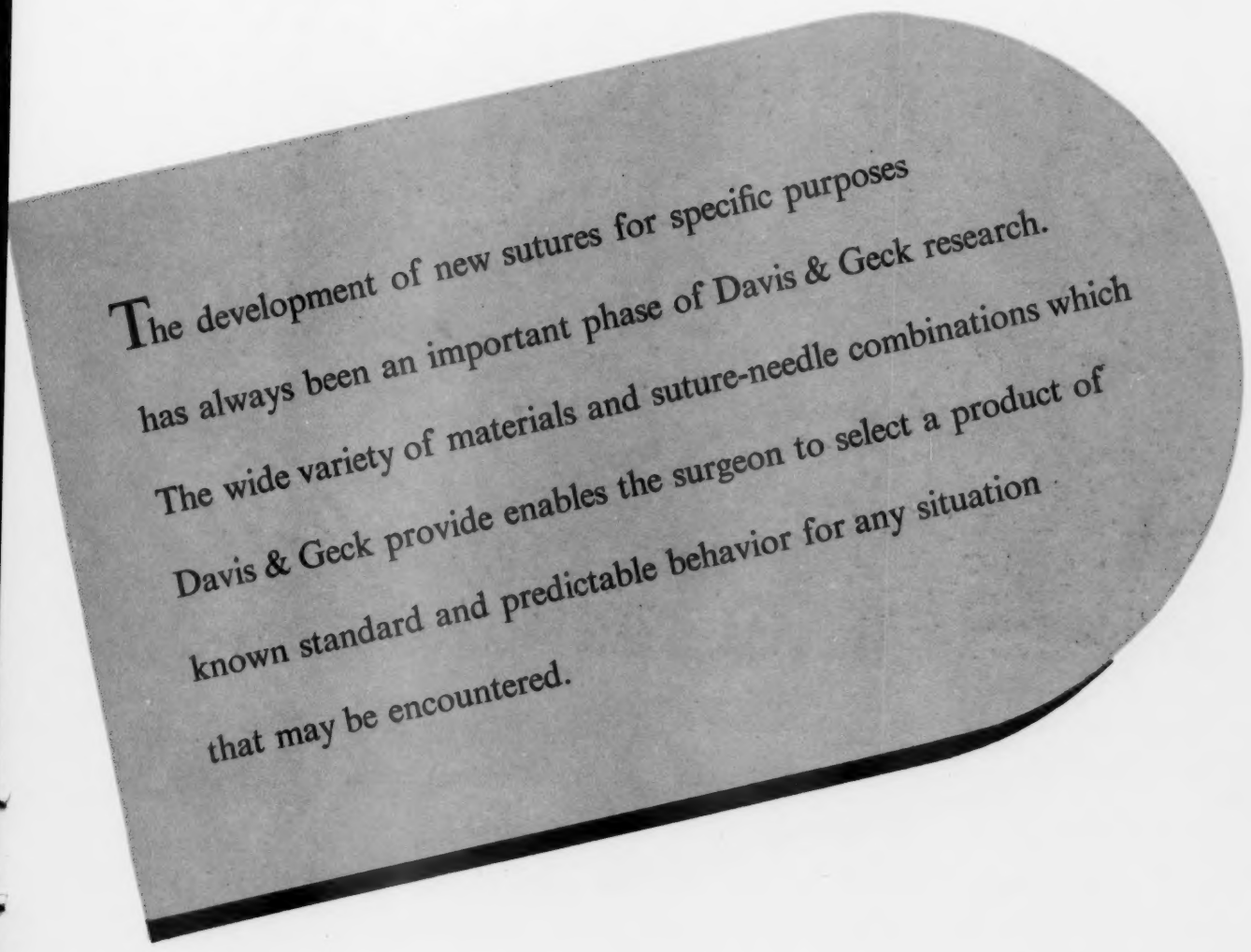
OTHER D & G SUTURES • Surgilon (*braided nylon*), ribbon gut, kangaroo tendons and bands, twisted silk, celluloid linen, cotton, silkworm gut, horsehair, etc., are available in comprehensive ranges of lengths and sizes.

DAVIS & GECK SUTURES WITH ATRAUMATIC NEEDLES FOR SPECIFIC PROCEDURES

•

INTESTINAL	*HERNIOPLASTY*	*THYROID*	*HARELIP*	*EYE*
CLEFT PALATE	*NEPHROPEXY*	*PLASTIC*	*ARTERY*	*NERVE*
OBSTETRICAL	*CIRCUMCISION*	*URETERAL*	*TONSIL*	*RENAL*

A list of sizes, lengths, suture-needle combinations and prices will be sent on request


The development of new sutures for specific purposes
has always been an important phase of Davis & Geck research.
The wide variety of materials and suture-needle combinations which
Davis & Geck provide enables the surgeon to select a product of
known standard and predictable behavior for any situation
that may be encountered.

SINCE 1909—*Surgical Sutures Exclusively*

In surgical catgut, for instance—the highest standards of quality can only be attained by utilizing fresh casings obtained at specific stages of animal maturity for the production of the various sizes and types of sutures required.

The rigid control that D&G exercises over this and every other phase of raw material selection, fabrication and processing is reflected in the uniformly superior quality of every suture bearing the D&G label.

ARMY E NAVY

DAVIS & GECK SUTURES

BROOKLYN 1 NEW YORK

READY SOON

1270 PAGES $8.00

A Textbook of Interpretations and Their Practical Applications

CLINICAL DIAGNOSIS BY LABORATORY EXAMINATIONS

By John A. Kolmer, M.D., F.A.C.P.

FEATURED BY

- 642 pages on The **Clinical Interpretations** of Laboratory Examinations
- 328 pages on The **Practical Applications** of Laboratory Examinations In Clinical Diagnosis
- 134 pages on The **Technic** of Laboratory Examinations
- 179 Clearly Detailed Illustrations including 25 in Color
- 137 Time Saving Diagnostic Summaries

For Sale At Your Local Store Or

D. APPLETON-CENTURY CO., Inc., 35 West 32nd St., N. Y. C.

The American Journal of Surgery, Inc.

Reg. U. S. Pat. Off., Nov. 3, 1936

NEW SERIES VOL. LXI — NUMBER Three

Contents · September, 1943

Editorial

War Organization of Plastic Surgery . . . . . *Jacques W. Maliniac* 313

Original Articles

Traumatic Rupture of the Kidney . . . . . *Payson Adams* 316

War Wounds . . . . . *J. Eastman Sheehan* 324

Burns as War Wounds . . . . . *J. Eastman Sheehan* 331

Tissue Grafting . . . . . *J. Eastman Sheehan* 339

Tumors of the Neck. Special Reference to Congenital Cysts and Fistulas . . *Edward W. Peterson* 350

Know Your Patient . . . . . *Jerome Morley Lynch* 360

Contents Continued on Page 3

For BASAL Anesthesia

BASAL anesthesia produced by the rectal instillation of a solution of Avertin with Amylene Hydrate generally lasts for two hours or more . . . With a relatively small dose of a supplemental anesthetic satisfactory muscular relaxation may be secured for a prolonged period . . . General anesthesia is usually maintained on a relatively high oxygen intake.

Avertin with Amylene Hydrate is supplied in bottles of 25 cc. and 100 cc., each 1 cc. containing 1 Gm. of Avertin and 0.5 Gm. of amylene hydrate.

Avertin

Trademark Reg. U. S. Pat. Off. & Canada

Brand of TRIBROMETHANOL

WITH AMYLENE HYDRATE

This cherished symbol of distinguished service to our Country waves from the Winthrop flagstaff.

WINTHROP CHEMICAL COMPANY, INC.

Pharmaceuticals of merit for the physician

NEW YORK, N. Y. WINDSOR, ONT.

The American Journal of Surgery

NEW SERIES VOL. LXI — NUMBER Three

Contents • September, 1943

Fractures of the Mandible. Report of Fifty Applications of the Roger Anderson Skeletal Fixation Appliance . . . . . *Leo Winter* 367

Inguinofemoral Anatomy. Aspects Significant for Inguinal Herniorrhaphy . *Edward J. Komora* 380

Ovarian Cysts Complicating Pregnancy . . . . . *A. J. Capone* 387

Uterography. An Aid in the Diagnosis of Gynecological Pelvic Disorders . . *Ben H. Brunkow* 394

Sulfathiazole Therapy in General Surgery . . . . . *G. Samuel Serino* 400

Aneurysms of the Coronary Arteries. Review of the Literature and Report of a Case . . . . . *R. H. Rigdon and Harris Vandergriff* 407

Suture Materials . . . . . *Louis E. Mahoney* 414

Significance of Schwannomas as a Factor in Obscure Cases of Appendicitis . . *William R. Laird and Lewis E. Nolan* 418

Evaluation of the McNealy Cecostomy . . . . . *John William Howser* 421

Intravenous Use of Morphine Sulfate . . . . . *Robert O. Pearman* 423

Case Reports

Primary Sarcoma of Duodenum. Resection with Head of Pancreas by One-stage Whipple Operation . . . . . *J. Dewey Bisgard and R. M. Cochran* 425

Malignant Hepatoma. Case Report . . . . . *Gregory L. Robillard and Charles Goldman* 430

Management of Gastrojejunocolic Fistula . . . . *Gilbert B. Tepper and Theodore B. Massell* 434

Gallstone Ileus. Pyloric Obstruction Caused by Gallstone *William I. Sheinfeld and Harry Mackler* 439

Method of Treating Cystic Tumors . . . . . *Francis M. Lyle* 443

Intestinal Obstruction Due to Gallstone . . . . . *L. M. Rankin and Sherman A. Eger* 445

New Instruments

Intestinal Clamps. A New Structural Principle . . . . . *Edgar J. Poth* 449

Modification of the Red Cross Wooden Traction Splint . . . . *First Lieut. Joseph Estrin* 451

Author Index to Volume LXI 453

Subject Index to Volume LXI 454

General Information on Page 4 *Advertising Index on 3rd cover*

General Information

THE AMERICAN JOURNAL OF SURGERY does not hold itself responsible for any statements made or opinions expressed by any contributor in any article published in its columns.

Articles are accepted for publication with the understanding that they are original contributions never previously published. All manuscripts are subject to editorial modification, and upon acceptance become the property of THE AMERICAN JOURNAL OF SURGERY, INC.

A reasonable number of illustrations are supplied free of cost; special arrangements must be made with the editor and publishers for excess illustrations and elaborate tables.

Reprints are furnished on order. Prices are quoted when articles are in page form.

Material published in THE AMERICAN JOURNAL OF SURGERY is copyrighted and may not be reproduced without permission of the publishers.

Change of address must reach us by the 15th of the month preceding month of issue.

PREPARATION OF MANUSCRIPTS

Text. Manuscripts are to be typewritten, on one side of the paper, with double spacing and good margins. The original should be sent to the editor and a carbon copy retained by the author.

Illustrations. Illustrations must be in the form of glossy prints or drawings in black ink (*never* in blue). On the back of each illustration the figure number, author's name and an indication of the top of the picture should be given. Legends for illustrations are to be typewritten in a single list, with numbers corresponding to those on the photographs and drawings. Please do not attach legends to the pictures themselves.

Bibliographies. Bibliographic references should be at the end of the manuscript, in alphabetical order, and not in footnotes. Each reference should include the following information in the order indicated: Name of author with initials; title of article; name of periodical; volume, page and year. The following may be used as a model:

PHANEUF, LOUIS E. Indications and technique. *Am. J. Surg.*, 25: 446, 1937.

The author should always place his full address on his manuscript.

The subscription price of THE AMERICAN JOURNAL OF SURGERY, is $10.00 per year in advance in the United States; $15.00 in Canada; and $12.00 in foreign countries. Current single numbers $2.00. All Special Numbers $4.00. Prices for such back numbers as are available will be quoted on request.

Address all correspondence to

The American Journal of Surgery, Inc.

49 WEST 45TH STREET · NEW YORK

Foresight in Surgery

Prostigmin Methylsulfate 'Roche' maintains intestinal and bladder tone, minimizing the incidence of abdominal distention and urinary retention following surgery. Surgeons who have the foresight to administer Prostigmin preoperatively usually prevent "gas pains" and avoid the necessity for catheterization during the postoperative period. Prostigmin is used by many leading surgeons as a prophylactic routine measure and is regarded as a valuable aid in affording a smoother convalescence to patients whose recovery otherwise might be retarded by post-operative complications due to intestinal or bladder atony . . .
HOFFMANN-LA ROCHE, INC., ROCHE PARK, NUTLEY, NEW JERSEY

• Supplied in two strengths: 1:4000 solution for prevention or prophylaxis; 1:2000 solution for treatment.

PROSTIGMIN *'Roche'*

Quoted

from one of more than 400 published papers

"I have had few cases of surgical shock since we have been using this anesthetic (Pentothal Sodium). The skin remains dry and warm, and you never see the profuse sweating as in ether anesthesia, with its tremendous fluid loss by the skin. Some of the complications reported by other operators I consider due to a lack of knowledge or to technique—tremors, hiccoughs, laryngospasm, sneezing and vomiting are due to failure to give atropine before the anesthetic, and also to insufficient anesthesia."

T. C. Davison, M.D., F.A.C.S.
Atlanta, Georgia
Intravenous Anesthesia in Modern Surgery (Sodium-Pentothal-Oxygen)
Anesth. and Analg., 22:52-56, Jan.-Feb., 1943

FOR INTRAVENOUS ANESTHESIA

Pentothal Sodium
REG. U.S. PAT. OFF.

[Sodium Ethyl-(1-Methyl-Butyl)-Thiobarbiturate, Abbott]

Descriptive literature will be sent upon request. Address inquiries to
ABBOTT LABORATORIES
North Chicago, Illinois

THE ACME OF PRECISION

This Jansen-Middleton Septum Punch

Milled by modern machinery to the minutest fraction of an inch, the new Weck-made Jansen-Middleton Septum Punch, shown above is truly the acme of precision.

Pictured here, 4/5ths size, with the cupped jaws, it is also in production with cutting-through jaws, as well.

But you must see the instrument itself, operate its firm grip, with just the right shape of handles—feel its positive action, to really appreciate what a superlatively fine surgical instrument is this American-made product.

Made from the highest grade of selected American-made steel, the work of American craftsmen, in an American plant, the Jansen-Middleton Septum Punch may be taken as typical of the instruments which are steadily replacing American reliance on German-made surgical instruments.

Whatever you need in the way of new instruments—WRITE WECK FIRST.

The "E" flag awarded Weck by the Army and Navy for excellence in production of surgical instruments.

Edward Weck & Co., Inc.
Manufacturers Surgical Instruments
SURGICAL INSTRUMENT REPAIRING · HOSPITAL SUPPLIES
135 Johnson Street Brooklyn, N.Y.

Wyeth's Phosphaljel is supplied in 12-fluidounce bottles*

PHOSPHALJEL WYETH'S ALUMINUM PHOSPHATE GEL

Effective in the treatment of gastrojejunal ulcer and other cases of peptic ulcer associated with a relative or an absolute deficiency of pancreatic juice, diarrhea, or a low phosphorus diet.

ACCEPTED MEDICAL ADS

*Reg. U. S. Pat. Off.

Phosphaljel contains 4% aluminum phosphate.

JOHN WYETH & BROTHER • INCORPORATED • PHILADELPHIA

Earlier Healing

1. Hand of 54-year-old male, showing 2nd degree burn sustained in oil burner explosion.

2. Same hand 10 days later, showing rapid healing as result of daily treatment with White's Vitamin A and D Ointment; complete restoration of function.

(Both photographs unretouched)

IN BURNS, WOUNDS, INDUSTRIAL INJURIES WITH *White's*

VITAMIN A and D OINTMENT

The local use of the vitamins A and D " . . . results in a remarkable regeneration of all sorts of tissue defects . . . wounds fill more quickly with granulations, epithelize more satisfactorily and heal more rapidly than with other methods. . . . "*

In major and minor burns of whatever location on the body—in slow-healing postoperative wounds and the crushing and avulsive soft-tissue injuries familiar to industry—excellent results have been obtained with the local application of White's Vitamin A and D Ointment.

White's Vitamin A and D Ointment provides the natural A and D vitamins of fish liver oils in the same ratio as found in cod liver oil in a suitable lanolin-petrolatum base. The Ointment possesses a pleasant odor.

Forms no tenacious coagulum
Destroys no epithelial elements
Minimizes skin grafting

Available in 1½ oz. tubes, 8 oz. and 16 oz. jars; 5 lb. containers. Ethically promoted—not advertised to the laity. White Laboratories, Inc., Pharmaceutical Manufacturers, Newark 7, N. J.

*Hardin, Parker C.: "Cod Liver Oil Therapy of Wounds and Burns," So. Surg. 10:301 (May) 1941.

White's PRESCRIPTION *vitamins*

Hemorrhoids rank comparatively high among the causes of lost "man hours." Today, more than ever, this should be a matter of concern to physicians.

Whenever non-surgical treatment is indicated, Anusol may be used with the knowledge that it will afford the kind of relief likely to keep the patient on his job. By their emollient properties Anusol Suppositories reduce inflammation, alleviate pain and check the bleeding. They contain no narcotic or anesthetic to give the patient a false sense of security.

We suggest that you give Anusol a trial in one of your ambulant cases; we shall be glad to send you a supply for that purpose.

SCHERING & GLATZ, INC.
113 West 18th Street, New York City

ANUSOL HEMORRHOIDAL SUPPOSITORIES

LIKE AN ICEBERG . . . .

IN ITS SUB-CLINICAL PHASE, malnutrition can be likened to an iceberg, in that the real danger lurks beneath the surface. Superficially it may reveal even less than one-ninth of its debilitating effects upon the individual.

Whenever protein depletion with concomitant impairment of normal protein metabolism is suspected, Aminoids, an extremely valuable protein supplement, is indicated.

Free from drugs, and derived by enzymic digestion from both animal and vegetable proteins, Aminoids is unusually well-tolerated. It contains the amino acids known to be in the source material, including those defined as essential . . . is readily soluble in hot or cold liquids: water, milk, tea, fruit juices, meat and vegetable broths. Aminoids combines pleasantly with breakfast cereals, and fortifies bland diets which may otherwise be deficient in proteins.

In actual or suspected protein depletion, where oral administration, the ideal route, is not contraindicated, Aminoids merits clinical endorsement.

Supplied in granular form, in bottles containing six ounces. One level tablespoonful provides 3.94 gm. of protein as hydrolysate. Dosage may be regulated to meet individual requirements.

Aminoids

REG. U. S. PAT. OFF.

A PROTEIN HYDROLYSATE PRODUCT

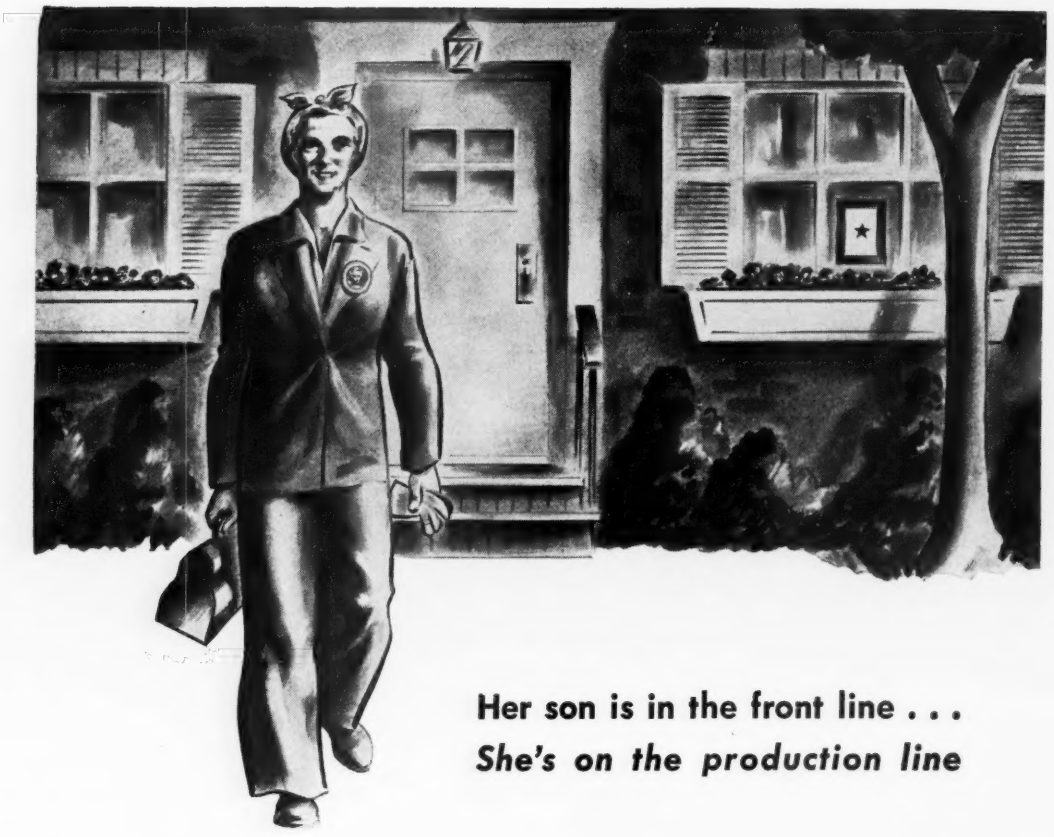
For Oral Administration

ACCEPTED AMERICAN MEDICAL ASSN. Council on Foods

THE ARLINGTON CHEMICAL COMPANY

YONKERS NEW YORK

Arlington



Her son is in the front line . . .
She's on the production line

WITH HER, parties and club meetings are "out for the duration." She's doing a man's job at the factory—helping to fill the gap and keep up production—until her boy, and millions like him, return. But, like so many women in their forties, she's wondering if she can keep fit—physically as well as emotionally.

There is ample clinical evidence to show that loss of time because of menopausal symptoms is today largely unnecessary. The distressing vasomotor symptoms of the menopause can be relieved by adequate therapy with natural or synthetic estrogens.

Both Amniotin (natural estrogenic substance) and Diethylstilbestrol Squibb (synthetic estrogen) are available in dosage forms for oral, hypodermic and intravaginal administration. In contrast to natural estrogens Diethylstilbestrol is only slightly less effective orally than intramuscularly and it is lower in cost. However, its high potency necessitates cautious use. It may therefore be advisable to build up the estrogenic level with Amniotin by injection and then maintain therapy with small oral doses of Diethylstilbestrol.

SQUIBB ESTROGENIC SUBSTANCES

AMNIOTIN . . . A highly purified, noncrystalline preparation of naturally occurring estrogenic substances derived from pregnant equine urine. Its estrogenic activity is expressed in terms of the equivalent of international units of estrone. Available in capsules for oral administration; solution for intramuscular injection; and vaginal suppositories.

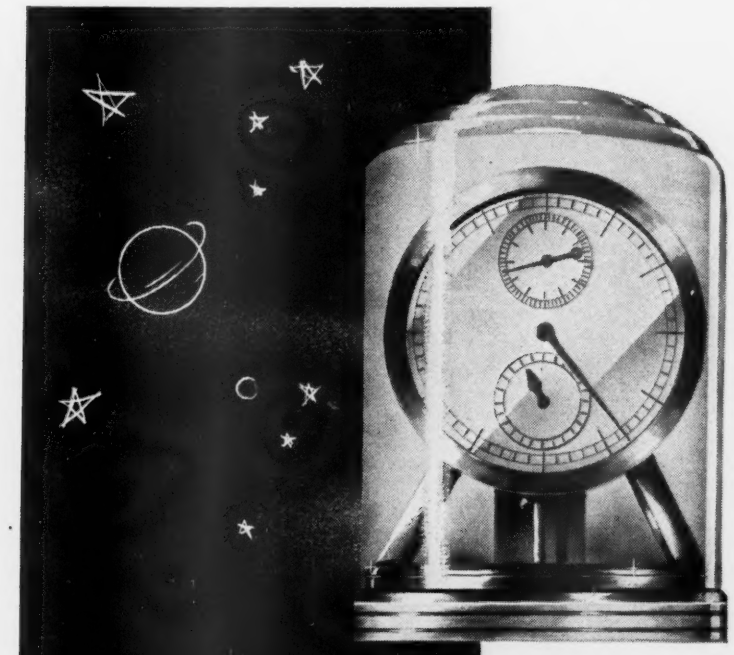
DIETHYLSTILBESTROL . . . A low cost synthetic estrogen possessing the physiologic properties of estrogenic substances derived from natural sources. Highly effective orally. Available in tablets for oral administration; solution for intramuscular injection; and vaginal suppositories.

For literature address the Professional Service Dept., 745 Fifth Ave., New York 22, N. Y.

E·R·SQUIBB & SONS

Manufacturing Chemists to the Medical Profession Since 1858

★ ***BUY MORE U. S. WAR BONDS*** ★



Consistent Performance

★ Unchanging, the Naval Observatory clock at Arlington has ticked on for decades. Its unvarying time is the accepted standard throughout the nation. The same consistent performance may be expected from PITOCIN* Rigid standardization and marked stability assure the same reaction today as yesterday and the day before.

★ PITOCIN'S potent oxytocic principle, negligible amount of pressor factor, low protein content and freedom from impurities assures stimulation of uterine contracture, no appreciable rise in blood pressure and a minimum possibility of reactions—true uniformity.

★ Chief indications for PITOCIN (alpha-hypophamine) are: medical induction of labor; stimulation of uterus, in properly selected cases, during labor; prevention of postpartum hemorrhage and bleeding following curettage; and treatment of postpartum and late puerperal hemorrhage.

*TRADE-MARK REG U. S. PAT. OFF.

PITOCIN

A product of modern research offered to the medical profession by Parke, Davis & Company

PARKE, DAVIS & COMPANY
DETROIT, MICHIGAN

All preparations of *Azochloramid* possess these special properties...

they are

Bactericidal

. . . against all types of micro-organisms

. . . in dilutions non-toxic to tissues

. . . over prolonged periods

. . . in the presence of pus and necrotic tissue

They are the most stable of all chlorine bactericides

They are strongly deodorant

For antiseptic dressings and packings that remain moist

SOLUTION OF AZOCHLORAMID IN TRIACETIN 1:500

and for particularly pain-sensitive areas

SOLUTION OF AZOCHLORAMID IN OLIVE OIL 1:2000 (prepared from Strong Solution of Azochloramid in Triacetin 1:125)

For lavage, irrigations, wet dressings and hot soaks

SOLUTION OF SALINE MIXTURE OF AZOCHLORAMID (aqueous, prepared from powder or tablets)

and where thorough penetration and liquefaction are essential

SOLUTION OF SURFACE ACTIVE SALINE MIXTURE OF AZOCHLORAMID (aqueous, prepared from powder)

For direct application—especially suitable for office and prescription use

OINTMENT OF AZOCHLORAMID 1:1000

ARMY E NAVY

BUY BONDS

Azochloramid
Reg. U. S. Pat. Off.
BRAND OF CHLOROAZODIN U.S.P.

Detailed literature and samples on request

WALLACE & TIERNAN PRODUCTS, INC.
Belleville, New Jersey, U.S.A.

W & J

In the surgeon's hands, too, thiamine has proved itself a potent therapeutic weapon. In thyrotoxicosis, the administration of large doses prior to surgery appears to make the patient a better surgical risk, to help him through the frequently stormy postoperative period. In the extirpation of varicosities, and in the treatment of varicose ulcers, thiamine in high dosage lessens the characteristic pain. Postoperatively, when large doses of glucose are given, the parenteral administration of thiamine usually proves beneficial. Bethiamin, the Massengill brand of crystalline thiamine hydrochloride, provides practically every dosage form which may be required.

BETHIAMIN

For oral administration, Bethiamin is available in capsules containing 1 mg., 3⅓ mg., 10 mg., and 15 mg.; for parenteral administration, in 1 cc. ampuls containing 1 mg., 10 mg., 50 mg., 100 mg. and in 10, 30 or 60 cc. rubber-capped vials. In liquid form Bethiamin Elixir contains 6 mg. of thiamine hydrochloride per fluidounce.

THE S. E. MASSENGILL COMPANY
Bristol, Tenn.-Va.

NEW YORK • SAN FRANCISCO • KANSAS CITY SEMCO

PRIODAX

TABLETS

for dependable cholecystograms

Accurate gallbladder diagnosis is now more certain with PRIODAX, a new contrast medium which owes its superiority to its form and composition.

Iodine, (51.5%) firmly bound, in a stable organic molecule produces reliable, clear pictures of uniform density by the "single-dose" method.

Contains no phenolphthalein or any related derivatives, thus reducing the possibility of diarrhea with loss of contrast material.

Tablet Administration and chemical nature favor retention. Vomiting ...so often associated with unpalatable powders...is *rare* with PRIODAX.

Administration: Six tablets swallowed whole in the course of a light fat-free evening meal. X-ray exposures are made in 12 and 15 hours.

PRIODAX, β-(4-hydroxy-3, 5-diiodophenyl)-α-phenyl-propionic acid, supplied in cellophane envelopes, each containing six tablets. Boxes of 1, 5 and 25 envelopes.

FOR VICTORY AND AFTER...BUY WAR BONDS

SCHERING CORPORATION · BLOOMFIELD · N.J.

THYROID
SUPRARENALIN
LIVER LIQUID
PITUITARY LIQUID
} Armour
These Are the Results of Specialized Experience, Technical Skill, and Exacting Standardization.

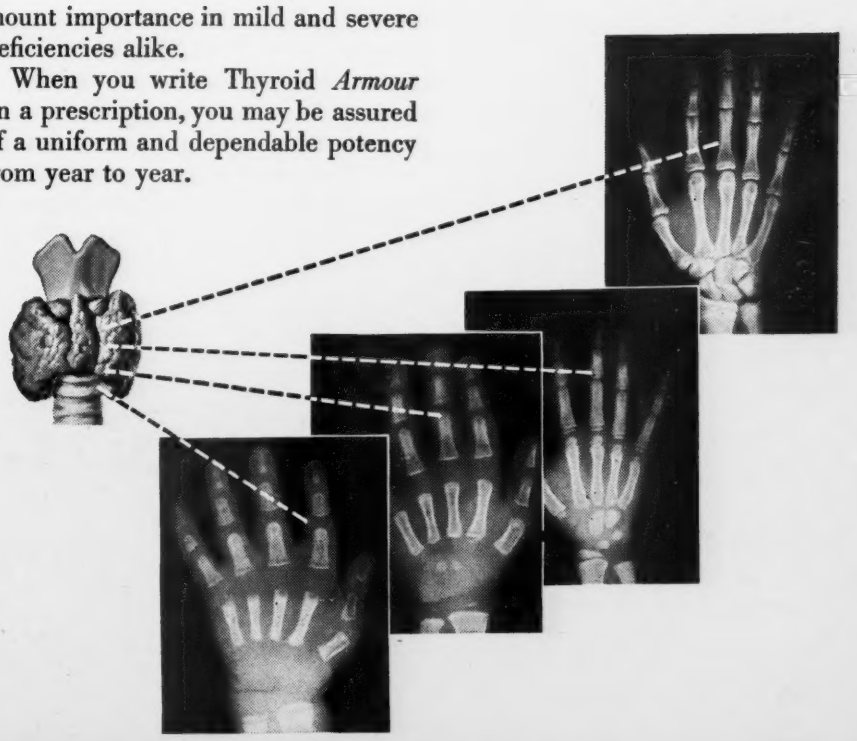
Bone Retardation in Hypothyroidism

NOWADAYS, the less marked degrees of thyroid deficiency are encountered more frequently than are frank myxedema or cretinism. The diagnosis of these milder syndromes often calls for considerable clinical acumen plus laboratory procedures. In children, the difficulty of executing reliable basal metabolism determinations further complicates the problem.

As a dependable diagnostic aid, Engelbach and others have emphasized the importance of a study of bone development, since in hypothyroidism the bone age tends to lag behind the chronologic age.

Once the diagnosis is established, and thyroid dosage determined, the uniformity and standardization of the thyroid medication become of paramount importance in mild and severe deficiencies alike.

When you write Thyroid *Armour* on a prescription, you may be assured of a uniform and dependable potency from year to year.



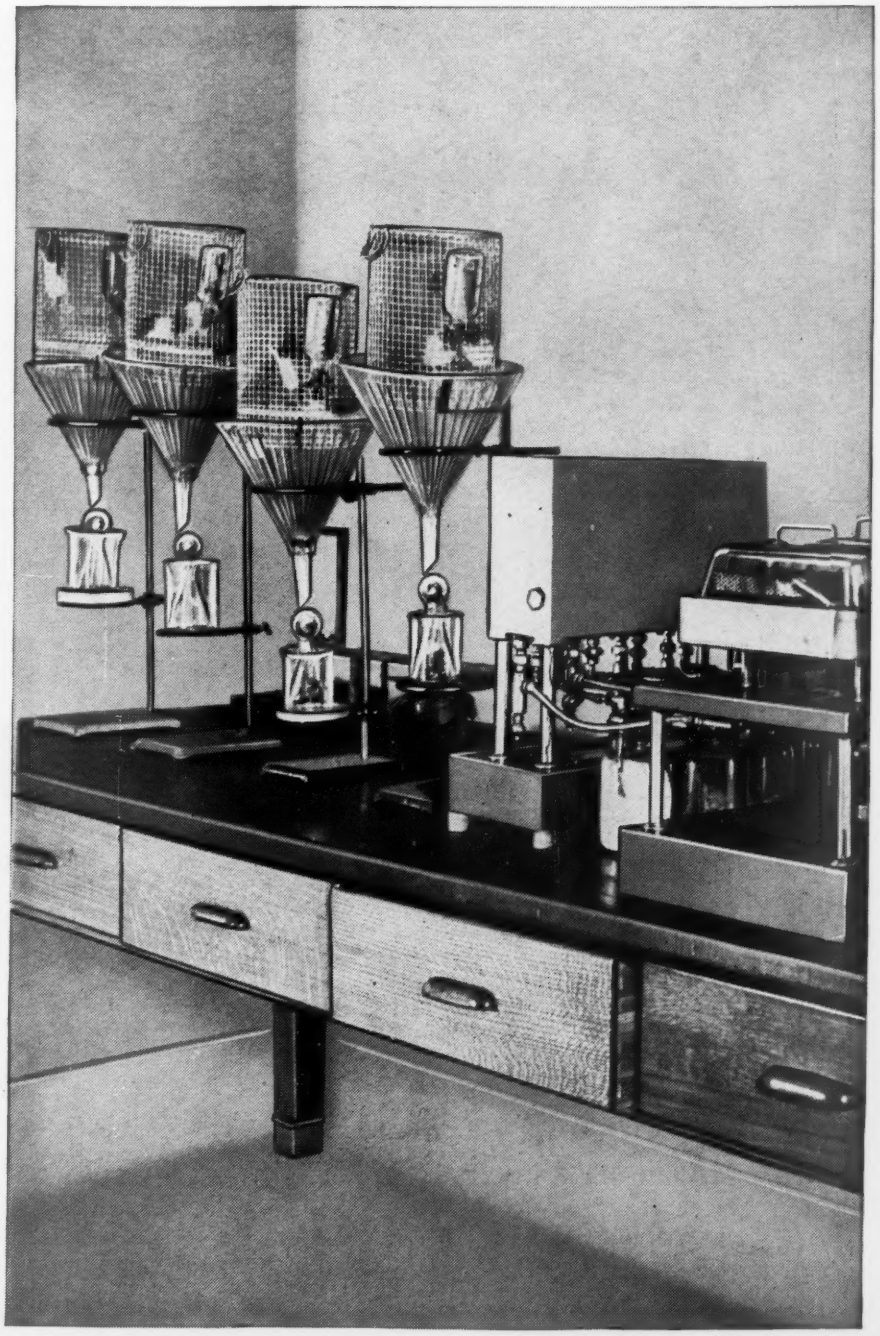
Improved Standardization . . .

A Detail in Perfectionism

EVERY possible care is taken to achieve greater perfection in the preparation of ARMOUR MEDICINALS. Only the very choicest of material is selected carefully from Armour's tremendous supply (the world's largest) of fresh animal tissues . . . and Armour technicians are skilled in selecting and judging of animal tissues. Every phase of the processing is under constant scrutiny and analysis by Armour scientists.

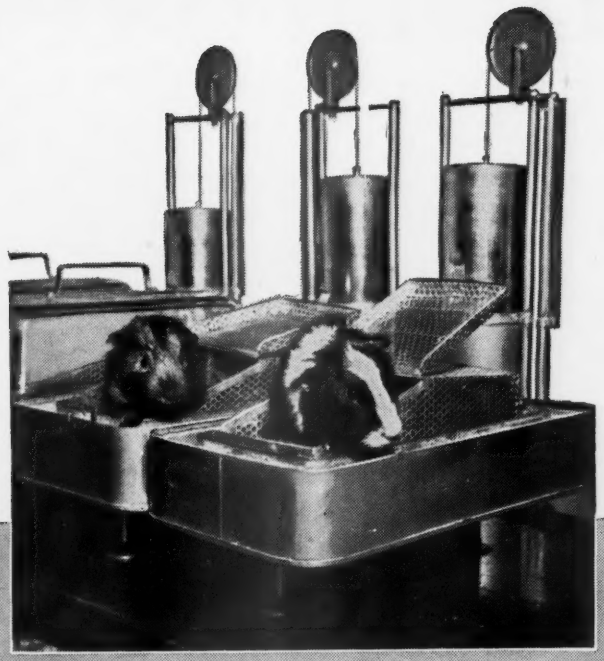
THYROID *Armour* is an example. Armour scientists were the first to recognize the regional and seasonal variation in animal thyroid. They instituted methods for overcoming this basic uncertainty in thyroid medication. In the preparation of THYROID *Armour* today the glands are carefully selected from regions where the relationships between thyroxin and other organic iodine content is relatively stable the year 'round. The glands are assayed and then blended to fixed standards. Finally, THYROID *Armour* is actually assayed for its metabolic stimulating effect. The illustration reproduced here shows equipment employed for this purpose.

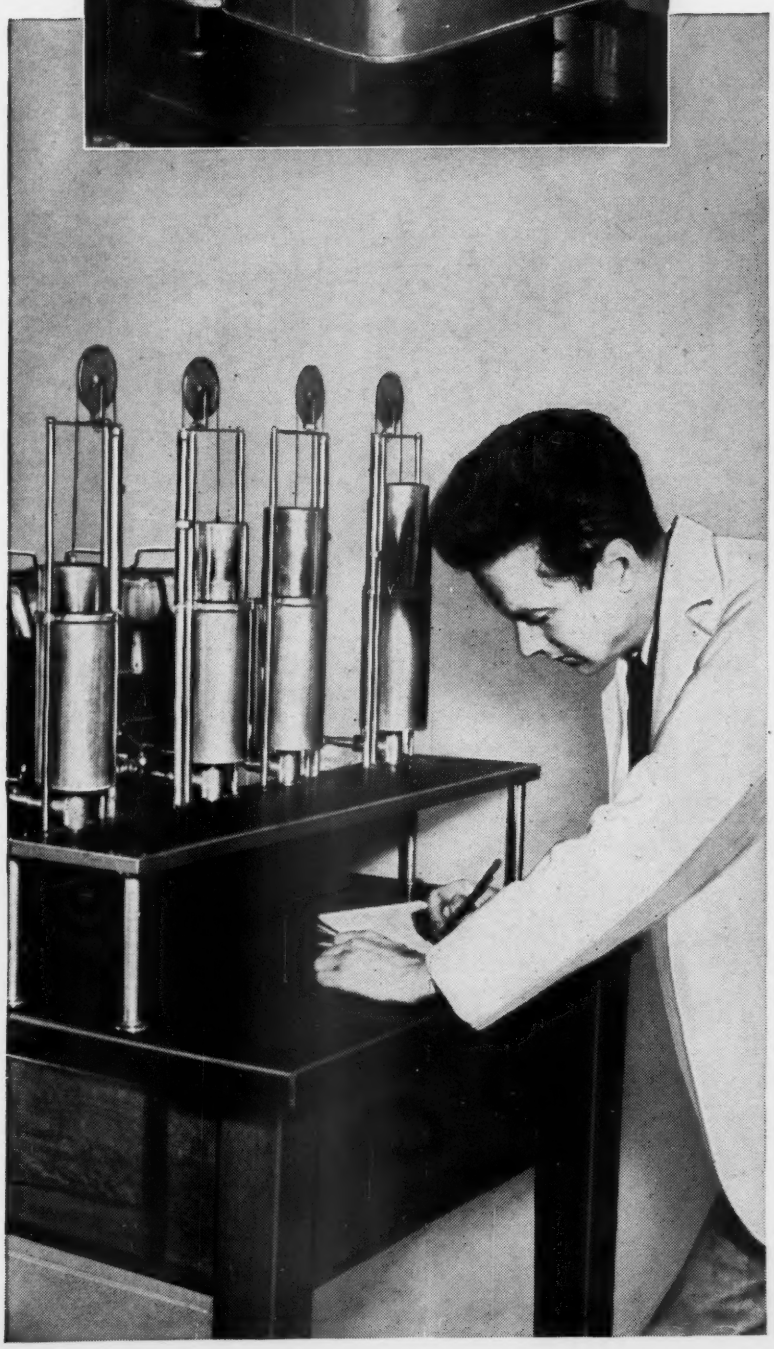
Such painstaking attention to every detail largely explains why ARMOUR medicinals of animal origin have achieved such widespread recognition for quality. It explains also why physicians can have confidence in the preparations they prescribe when they specify "ARMOUR."



It is sound practice to specify "ARMOUR" whenever ordering or prescribing

THE ARMOUR LABORATORIES
Chicago, Illinois
Headquarters for Medicinals of Animal Origin





These Are the Results of the Armour Laboratories' Specialized Experience and Techniques

SOLUTION LIVER EXTRACT ORAL ARMOUR

A readily assimilable, therapeutically effective preparation for use by the oral route. Tested for hemopoietic potency on pernicious anemia patients in relapse. 45 cc. equal 1 U. S. P. Unit (Oral).

PITUITARY LIQUID ARMOUR (A BRAND OF SOLUTION OF POSTERIOR PITUITARY INJECTION U. S. P.)

This sterile solution of the physiologically active constituents of the posterior lobe of the pituitary body is standardized on the guinea pig uterus for its oxytocic potency. Supplied in 1/2 and 1 cc. ampuls, 10 U. S. P. Units per cc.

LIVER LIQUID PARENTERAL ARMOUR

Available in three concentrations: 4, 10 and 15 U. S. P. Units (Injectable) per cc. In 1, 5, and 10 cc. rubber-capped vials. Standardized for hemopoietic potency on pernicious anemia patients in relapse.

THYROID ARMOUR

In preparing Thyroid Armour, only carefully selected animal glands are used. Thyroid Armour is standardized by the U. S. P. Chemical Assay method . . . and in addition, Animal Basal Metabolism tests are run as a double-check of its activity. It conforms to U. S. P. specifications, and is available in 1/10, 1/4, 1/2, 1, 2 and 5 grain tablets, and in powder.

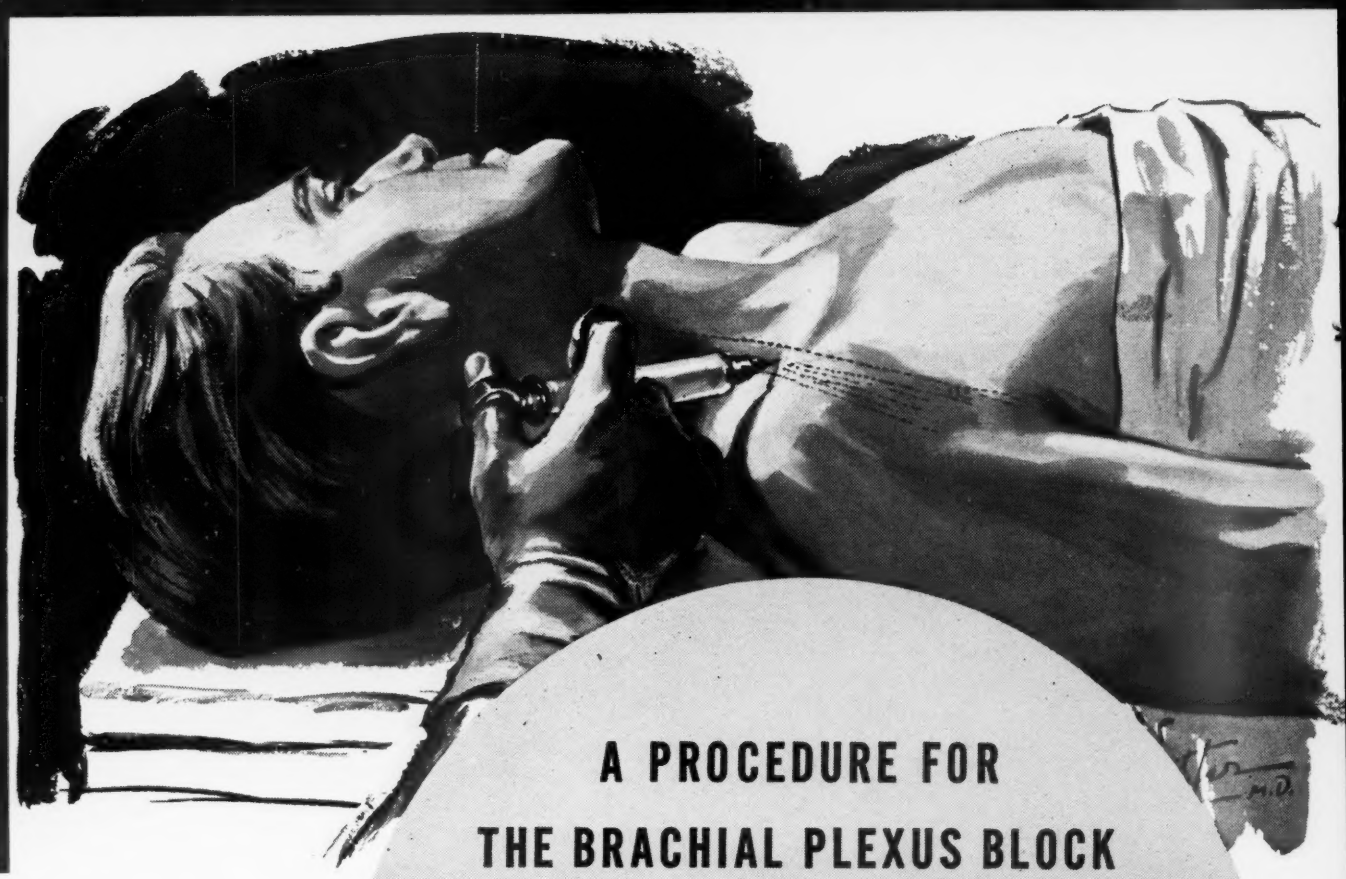
SUPRARENALIN SOLUTION ARMOUR 1:1000 (EPINEPHRINE HYDROCHLORIDE)

This solution is prepared from epinephrine crystals isolated from the suprarenal medulla. It is indicated in local and topical anesthesia, asthma, urticaria, heart block, anesthesia accident, etc. Available in 1 cc. ampuls, in 5, 10 and 30 cc. rubber-capped vials, and in 1 oz. bottles for topical use.

ARMY-E-NAVY

For Excellence in War Production

Brachial Plexus Block



A PROCEDURE FOR THE BRACHIAL PLEXUS BLOCK

In the supraclavicular approach, the needle is introduced 1 cm. above the middle of the clavicle. This is usually just lateral to the external jugular vein. The pulsations of the subclavian artery may often be palpated here and the vessel is pressed out of the way by the index finger. The needle is directed downward and medially. Just after passing through the deep fascia at a depth of 2 to 3 cms., paresthesia in the fingers may be induced. This is the indication for injection of 10 cc. of 2 per cent procaine solution to which a few drops of Suprarenalin *Armour* (1:1000) have been added. It is also advisable to inject a subcutaneous ring of the anesthetic solution about the arm.

THE brachial plexus block is assuming a role of increasing importance in both military and civil practice. It is applicable for almost any operation on the deep or superficial tissues of the upper extremity.

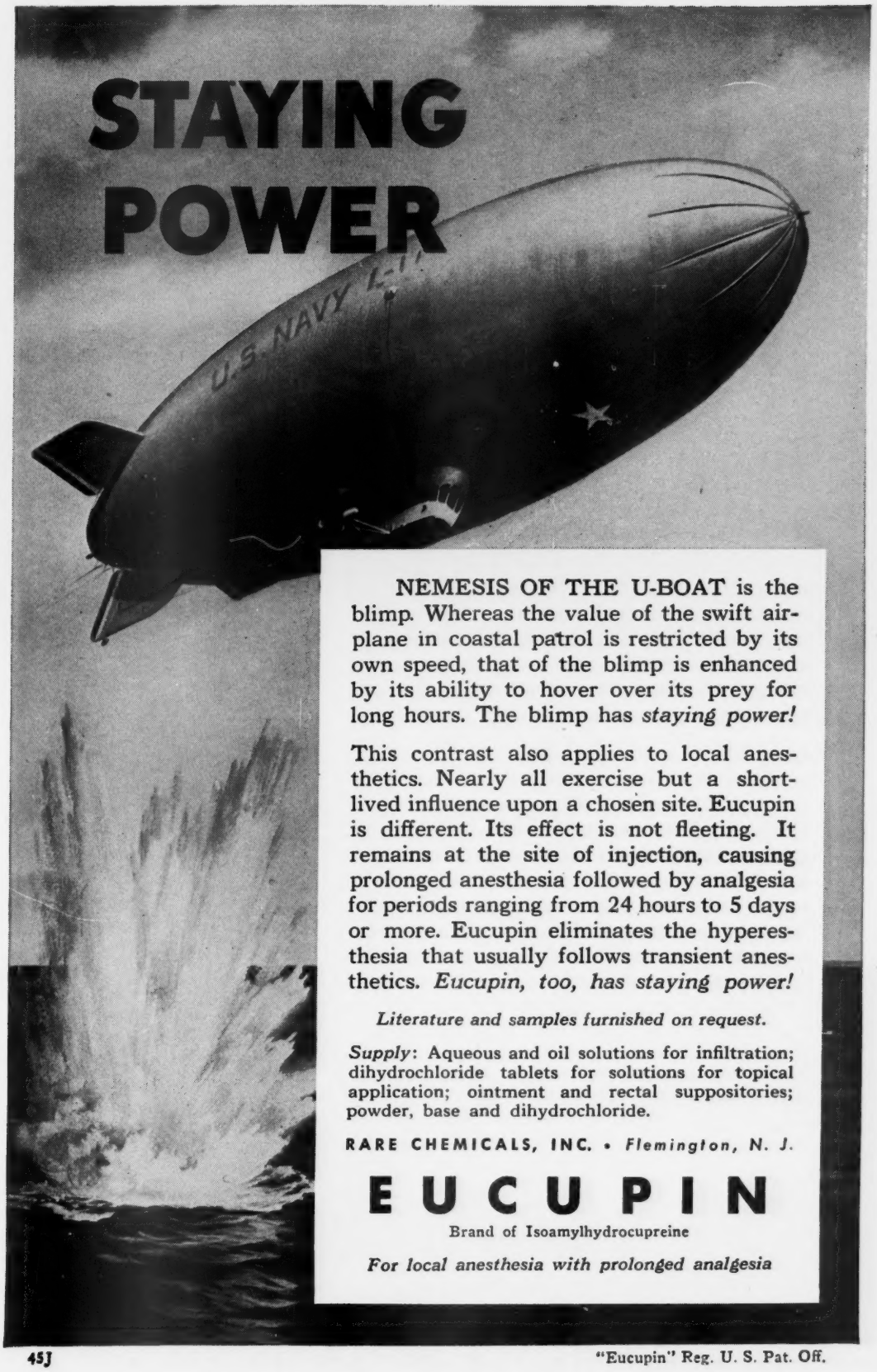
The addition of Suprarenalin *Armour* to the local anesthetic agent used, prolongs the effect by inducing a local vasoconstriction and slowing the absorption. At the same time, this lessens the likelihood of systemic toxicity.

It is sound practice to specify Suprarenalin *Armour*, whether you are using it in local anesthesia or to treat some emergency such as anesthesia accident, nitritoid crisis, asphyxia, or asthmatic paroxysm.

Suprarenalin *Armour* is prepared from the crystals of epinephrine derived from choice animal glands selected from the world's largest supply of endocrine raw material. And it is processed according to the most modern methods by the skilled technicians of the Armour Laboratories.

Have confidence
in the preparation you administer . . .
Specify ARMOUR

THE ARMOUR LABORATORIES
CHICAGO, ILLINOIS



NEMESIS OF THE U-BOAT is the blimp. Whereas the value of the swift airplane in coastal patrol is restricted by its own speed, that of the blimp is enhanced by its ability to hover over its prey for long hours. The blimp has *staying power!*

This contrast also applies to local anesthetics. Nearly all exercise but a short-lived influence upon a chosen site. Eucupin is different. Its effect is not fleeting. It remains at the site of injection, causing prolonged anesthesia followed by analgesia for periods ranging from 24 hours to 5 days or more. Eucupin eliminates the hyperesthesia that usually follows transient anesthetics. *Eucupin, too, has staying power!*

Literature and samples furnished on request.

Supply: Aqueous and oil solutions for infiltration; dihydrochloride tablets for solutions for topical application; ointment and rectal suppositories; powder, base and dihydrochloride.

RARE CHEMICALS, INC. • *Flemington, N. J.*

EUCUPIN

Brand of Isoamylhydrocupreine

For local anesthesia with prolonged analgesia

45J

"Eucupin" Reg. U. S. Pat. Off.

THE *Multi-Purpose* CONTAINER

FOR SOLUTIONS, BLOOD AND PLASMA

For collection, storage, refrigeration and administration

Economical . . . both container and vacuum seal are reusable

No transportation problems . . . insures a constant, adequate supply

Will accommodate new reusable inside vent tube which filters as it dispenses

A container especially designed for use with the International B-P centrifuge

Lowers cost of maintaining and operating all 3 essential services

Send for Technical Manual

describing in detail the operation and care of Fenwal equipment · formulae · suggested technics for preparation, processing, storing and administration.

MACALASTER BICKNELL COMPANY

243 Broadway Cambridge, Massachusetts

Fenwal

THE SOLUTION DESIRED AT THE INSTANT REQUIRED

The local and constitutional bacteriostatic treatment of burns with . . .

SULFADIAZINE

Lederle

BACTERIOSTATIS is essential for healing in extensively burned areas. This may be achieved by appropriate surgical and medical measures adopted immediately after the injury is received. The most important bacteriostatic measure is the use of sulfonamides.

SULFADIAZINE *Lederle* may be employed locally in the form of "SULFADIAZINE IN ETHANOLAMINES SOLUTION (PICKRELL)" *Lederle*, or "SULFADIAZINE OINTMENT" *Lederle*.

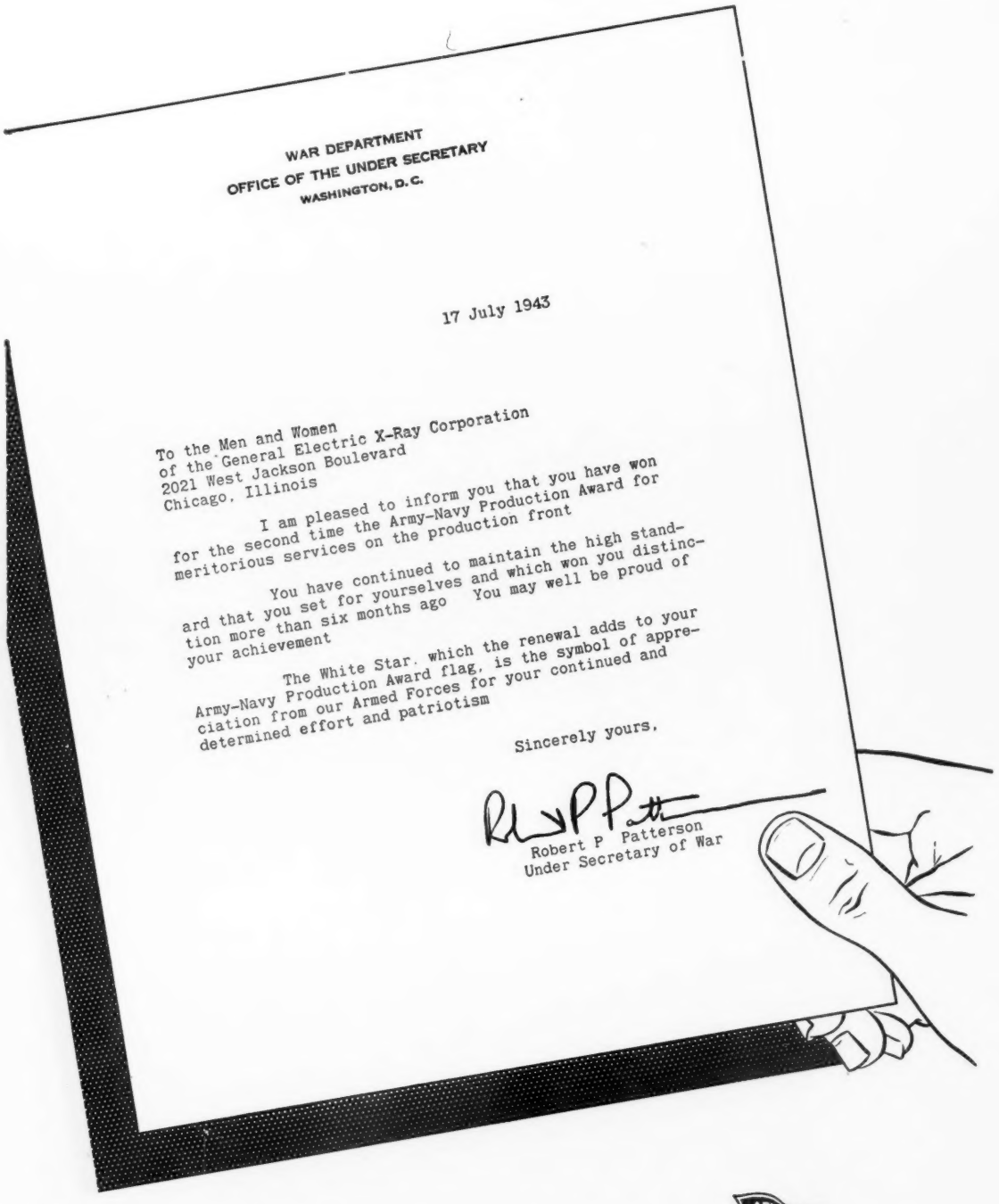
SULFADIAZINE *Lederle* may be given by mouth if drug blood levels remain insufficient to inhibit bacterial growth. Caution should be observed in the simultaneous use of oral and local therapy since excessive drug blood levels may result. Maintenance of urinary output between 1,000 and 1,500 cc. daily and an alkaline urine are advisable during intensive Sulfadiazine therapy.

PACKAGES:

Sulfadiazine in Ethanolamines Solution (Pickrell) *Lederle*
Available in bottles of 8 oz. and 1 pt.

Sulfadiazine Ointment 5% *Lederle*
Available in tubes of 1 oz., 4 oz. and 1 lb.

LEDERLE LABORATORIES A UNIT OF AMERICAN CYANAMID COMPANY INC.


WAR DEPARTMENT
OFFICE OF THE UNDER SECRETARY
WASHINGTON, D.C.
17 July 1943
To the Men and Women
of the General Electric X-Ray Corporation
2021 West Jackson Boulevard
Chicago, Illinois
I am pleased to inform you that you have won for the second time the Army-Navy Production Award for meritorious services on the production front
You have continued to maintain the high standard that you set for yourselves and which won you distinction more than six months ago You may well be proud of your achievement
The White Star, which the renewal adds to your Army-Navy Production Award flag, is the symbol of appreciation from our Armed Forces for your continued and determined effort and patriotism
Sincerely yours,
Robert P Patterson
Under Secretary of War

G-E STANDARDS ARE SET UP TO BE MAINTAINED—IN WAR AND IN PEACE

ARMY E NAVY

GENERAL ELECTRIC
X-RAY CORPORATION
2012 JACKSON BLVD. CHICAGO (12), ILL., U. S. A.

Today's Best Buy—U. S. War Bonds

Integrity

The RED LILLY stands for quality products, progress through research, and ethical dealing with the medical profession. These precepts are not an idle pose but are the basis on which the Lilly Laboratories have operated for over sixty-five years.

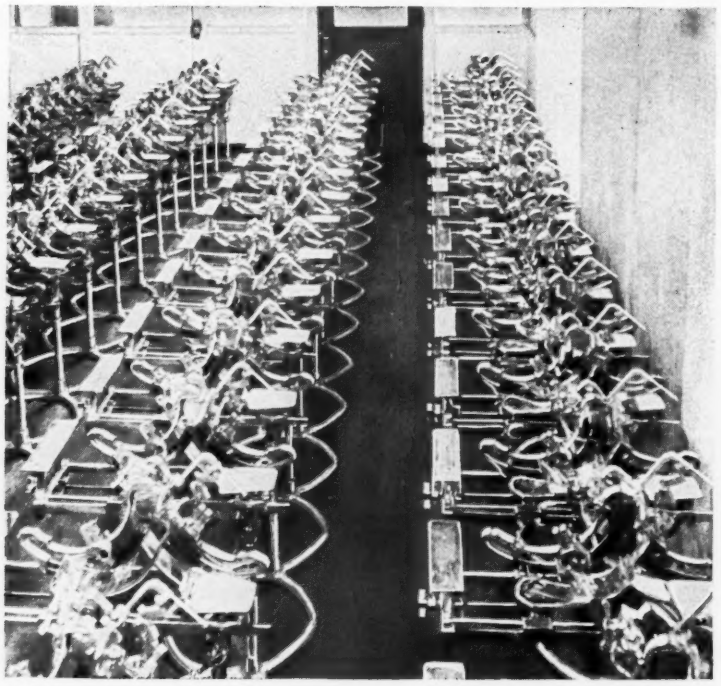
Lilly

ELI LILLY AND COMPANY

INDIANAPOLIS 6 INDIANA U. S. A.

BUY WAR BONDS AND STAMPS

Now Serving On All Fronts

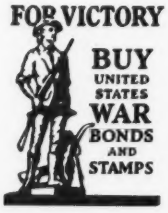


Roger Anderson Anatomic Reduction Splints inspected and ready for shipment to the Medical Corps of the Allied armed forces.

The heavy demand for this equipment by the armed services has made it impossible for us to fill many of your orders. We have appreciated your cooperation and patience and are endeavoring to make some of this equipment available to you in the near future.

Booklet on Fracture Technic furnished on request.

NOTE TO MILITARY AND CIVILIAN HOSPITALS: Technicians available for demonstrating Frac-Sure Equipment without obligation.



Sole Manufacturers and Distributors

The TOWER COMPANY Inc.
HOME OFFICE
1008 Western Ave.
Seattle 4, Wash.
MAin 4443
Cable Address "TICSEATTLE"

THE TOWER CO. INC.
SEATTLE, U.S.A.

SURGICAL DISTRIBUTORS, Inc.
REPRESENTATIVES
120 S. La Salle Bldg.
Chicago 3, Illinois

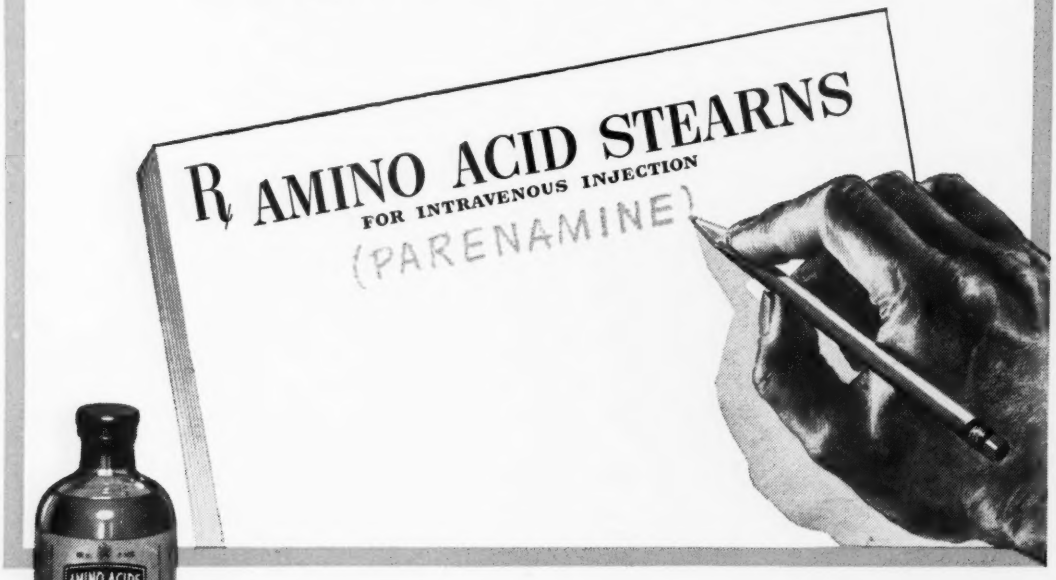
11 West 42nd Street
New York City 18, N. Y.

Manufacturing and Research Specialists in Fracture Equipment

Leading the Way—
TIMED to the second and protected by our powerful air fleet, America's intrepid Paratroopers lead the way in our invasion of Europe. No less gallant are the medical troops who follow close behind—on the job day and night, wherever and whenever needed. The nation pays tribute to the skill and bravery of these fearless soldiers of mercy. Modern science has provided our Military Surgeons with superb equipment. Sklar surgical instruments rank high among such equipment, serving flawlessly on scores of battle fronts all over the world just as they have served American surgeons at home for more than fifty years.
J. SKLAR MANUFACTURING COMPANY
LONG ISLAND CITY, N. Y.
★
Instruments available for civilian use are limited in quantity. We are continuing to do our best to meet the most urgent civilian needs. Preserve and conserve the instruments you have, that they may serve as long as possible.

An Added Safeguard Against Confusion

A New Registered Name



Now, to make doubly sure that you will obtain exactly what you require when you specify parenteral amino acids, Stearns has registered the trade name "Parenamine" as additional identification of Amino Acids Stearns—the first effective parenteral substitute for protein alimentation.

And here is more news about this widely discussed contribution to pre- and post-operative care and to the study and treatment of nutritional deficiencies: steadily increasing production assures that hospitals, clinics and individual physicians will soon be receiving enough to meet present requirements. Moreover, because demand continues to grow at an increasing rate, Stearns is already planning greater production facilities.

Frederick Stearns & Company

Since 1855 . . . ESSENTIALS OF THE PHYSICIAN'S ARMAMENTARIUM

NEW YORK KANSAS CITY SAN FRANCISCO WINDSOR, ONTARIO **DETROIT, MICH.** SYDNEY, AUSTRALIA AUCKLAND, NEW ZEALAND

ETHICON SUTURE

"FUTURES"

NO. III

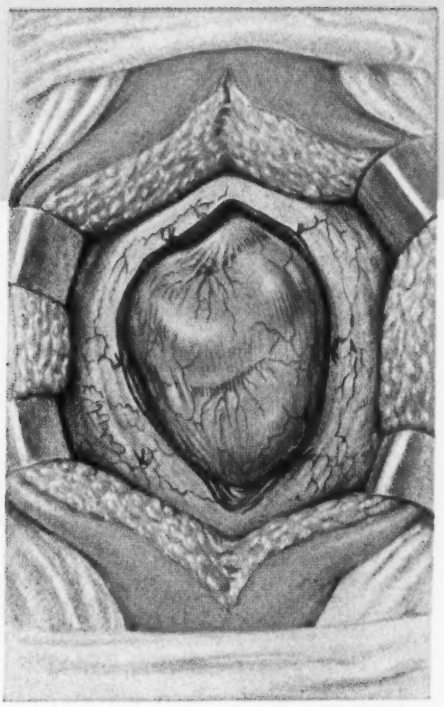
THE OPERATING ROOM OF TOMORROW . . . Equipment now used at a famous university points to the day when groups may see operations as clearly as if each observer stood beside the surgeon . . . A mirror controlled from a projection booth can reflect the operative field into an epidiascope, the image appearing on a screen. For modern advancements in suture making, see the following pages. ⟶

Herniotomy for Ventral Hernia

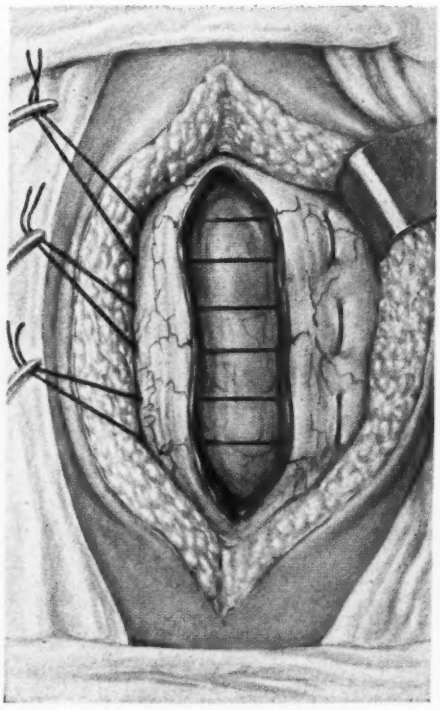
Utilizing Fine Gauge Chromic Catgut and Modification of Edebohl's Technic

This operation demonstrates the manner by which fine gauge chromic catgut may be used to approximate fascia under tension. The placing of heavy gauge temporary tension sutures and secondary incisions make possible thorough and firm approximation by fine gauge chromic sutures.

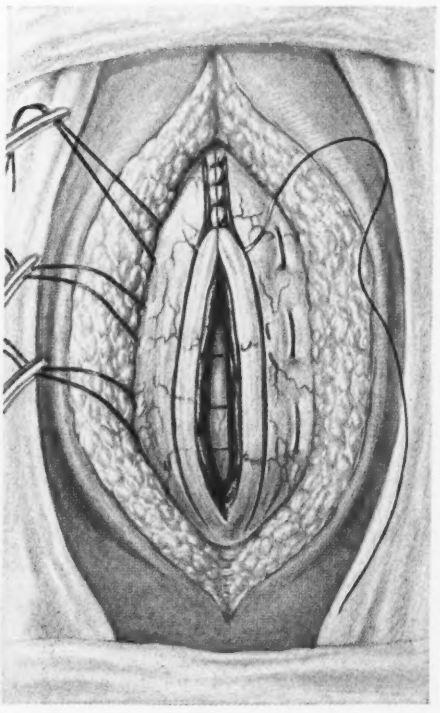
The established principle of the desirability of minimizing tissue reaction is here applied in the use of fine gauge chromic catgut where heavy gauge or non-absorbable suture materials were formerly utilized.



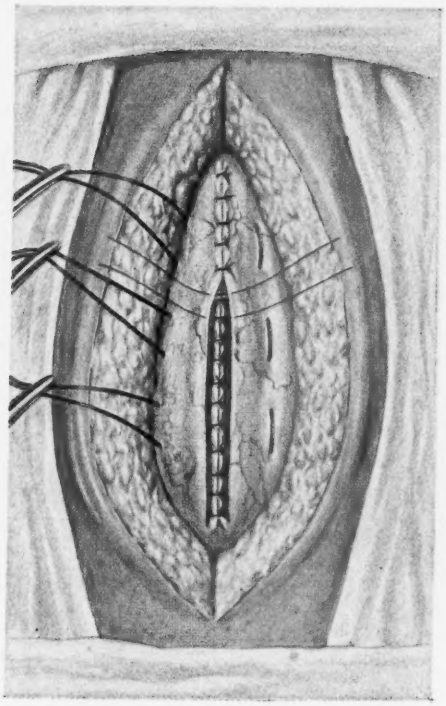
1. The incision has been carried through to the peritoneum. Bleeders have been ligated with Size 000 Medium Chromic Catgut. Note extent of fascial defect.



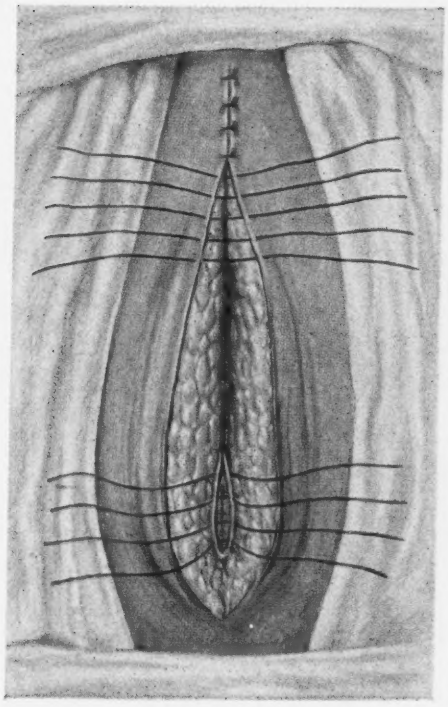
2. Wide area of lateral fascia has been exposed. Three mattress sutures of Size 3 Chromic Catgut or heavy silk have been placed to provide temporary tension.



3. Two longitudinal fascial incisions have been made. The fascia is drawn together by tension applied to temporary sutures and a row of interrupted Size 00 Chromic Catgut Sutures placed. Note use of swedged needle to reduce trauma.



4. Initial row of fascial sutures has been completed. Second layer of fascia is now approximated by interrupted Size 00 Chromic Catgut Sutures.



5. Herniotomy completed with two layers of fascia approximated by interrupted fine gauge chromic sutures. Temporary tension sutures have been removed. Skin closure by interrupted black silk.

You may now use finer gauge sutures with confidence

• Fine gauge suturing, with its benefit of minimal tissue reaction, is facilitated with Ethicon. Exceeding U.S.P. tensile strength requirements (averaging 20% or more on knot pull in Sizes 00 and 000), Ethicon gives you a margin of safety against breakage and promotes integrity of catgut in tissue.

The end-to-end uniformity of gauge of every Ethicon suture, achieved through Johnson & Johnson's exclusive Tru-Gauging process, assures uniformity of tensile strength.

To guard against premature absorption in tissue, Ethicon's exclusive Tru-Chromicizing process gives uniform chrome deposition from center to circumference. Ethicon's exclusive Lock-Knot Finish exerts a gripping action that helps lock the knot readily, without undue tension that might cut or strangulate tissue.

ETHICON

LOCK KNOT

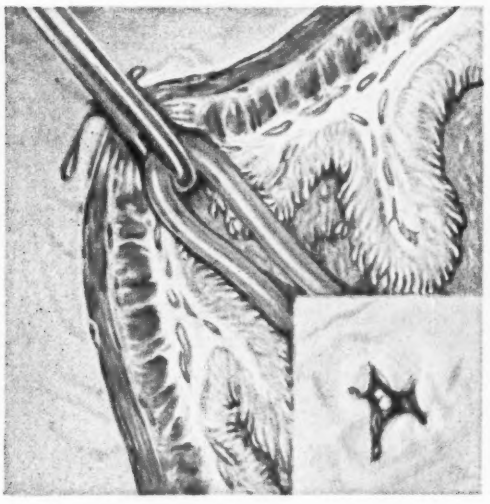
SUTURES

Johnson & Johnson

ETHICON
LOCK KNOT
SUTURES

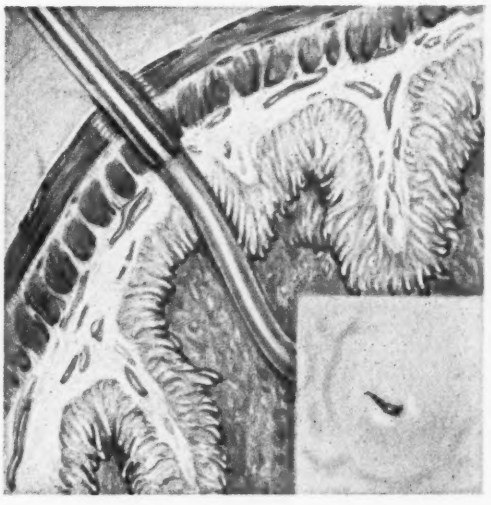
Atraloc Needles

FOR MINIMAL SUTURE TRAUMA



EYED NEEDLE

The eyed needle does greater injury to tissue because it pulls a looped suture in its wake.



ATRALOC NEEDLE

The Atraloc needle causes minimal injury. It pulls a single strand, slightly smaller than the needle.

ATRALOC NEEDLES HAVE SUPERIOR HOLDING POWER

● The name "Atraloc" designates our uniquely designed swaged needle, which is attached to the suture by our own exclusive process. The shank of the Atraloc needle is specially constructed to give maximum holding power on the suture. Extensive laboratory tests have proved that Atraloc needles hold on pulls in excess of U.S.P. tensile strength requirements for sutures pulled over a surgeon's knot.

The Ethicon line contains a wide selection of sutures with Atraloc needles, straight or curved, in all approved designs and sizes.

ETHICON SUTURE DIVISION

Johnson & Johnson

World's Largest Manufacturer of Surgical Catgut

Suture Laboratories at New Brunswick, N. J.; Chicago, Ill.; Brazil; Argentina; England; Australia

Copyright 1943, Johnson & Johnson Printed in U. S. A.

The American Journal of Surgery

Copyright, 1943 by The American Journal of Surgery, Inc.

A PRACTICAL JOURNAL BUILT ON MERIT

Fifty-second Year of Continuous Publication

NEW SERIES VOL. LXI SEPTEMBER, 1943 NUMBER THREE

Editorial

WAR ORGANIZATION OF PLASTIC SURGERY*

IN the overnight conversion of a peaceful nation's medical organization to a military basis, certain mistakes are inevitable. In justice to the men in the armed forces, however, they must be speedily corrected, even when this entails departure from old habits and points of view.

We cannot afford slavish adherence to old routines or a complacent wait-and-see attitude. Failure to make the best possible use of our medical resources will mean deformity, disfigurement and disability to thousands upon thousands of young men who might otherwise be restored to normal life.

In the field of reparative surgery it would be highly desirable to follow the example of leading civilian hospitals and recognize plastic surgery as a distinct specialty. Only in this way can we ensure the early application of correct plastic principles.

The creation of maxillofacial centers to handle reparative surgery in the last war was a natural development of the conditions which prevailed then. Although plastic surgery was not unknown, it was not a distinct specialty and there were neither established plastic services nor surgeons working exclusively in that field. Under those circumstances, military medical units were unprepared to deal with the preponderance of injuries of the face and mandible resulting from trench warfare.

After two years of mounting casualties of this nature, Lane and Gillies in England, and Morestin, Sebileau and Lemaitre in France, officially organized maxillofacial centers to handle them.[1] At that time it was logical to place this work mostly in the hands of otorhinolaryngologists, working in conjunction with prosthetic oral surgeons since there were no trained specialists in plastic surgery.

Although the creation of maxillofacial centers was a distinct advance, it was never a completely satisfactory arrangement. For one thing there was no provision for early treatment designed to prevent deformity and loss of function. Emphasis on late care, plus a dearth of qualified plastic surgeons, greatly protracted treatment and often failed to produce an acceptable cosmetic and functional result.

Blair made pertinent comment on the results of early versus late treatment in an address before the Southern Surgical Association in December, 1940.[2] Reviewing 340 late burn cases treated in his service during the twenty years following the Armistice, he remarked: "The average time that had elapsed between injury and

[1] GILLIES, H. D. Plastic Surgery of the Face. Preface. Oxford University Press, 1920.

[2] BLAIR, V. P. The role of the plastic surgeon in the care of war injuries. *Ann. Surg.*, June, 1941.

* Read before the Annual Session of the American Society of Plastic Reconstructive Surgery, Baltimore, December 11, 1942.

inauguration of surgical repair was 5.1 years. The aggregate period of disability . . . from the time of injury until final discharge was 2,312 years or an average of 6.8 years for each case. From our experience of the earlier care of deep burns of similar extent," he continued, "it seems fair to assume that with more constructive treatment the great majority of the above 340 cases could have been successfully restored to approximately normal function and acceptable appearance within three months from the time of injury, with half the number of repair operations and very much better average results than was possible with these late-treated cases. Reducing the average disability period for each of the above treated cases from 6.8 years to the estimated average of three months per properly early-treated cases would reduce the total disability period of the whole group from 2,312 years to 82 years." This is extremely significant in view of the great number of extensive burns produced by modern weapons of war.

Blair, who headed the Maxillo-facial Section of the United States Army in the last war and who, with John Staige Davis, Ferris Smith, Robert Ivy and a few others, is largely responsible for the development of plastic surgery in this country, was quick to perceive that the conditions which dictated the creation of a maxillo-facial division in the last war no longer exist to the same extent. As he observed in the address already referred to, unless trench warfare returns, faciomaxillary surgery will not attain the prominence it acquired in the last war and should give way to general plastic surgery. In his own words, "Many of the same type of surgeons as those who responded to the call for Facio-maxillary Units have, in civilian practice developed special skill for working in every part of the body, and in war surgery these could be just as economically and humanely valuable as in civil practice."

John Staige Davis was one of the first to recognize the need for a Division of Plastic Surgery in the Army to care for all casualties requiring plastic repair.[3] Even in the last war he urged that the Faciomaxillary Section be expanded to include all cases in need of plastic reconstruction; but, as he stated before the Southern Surgical Association in December, 1940, he could not "put it over, as there was no appreciation of the necessity of general plastic surgery by those with the power to act." Like others, including myself, he again urged this step in the current emergency, but so far without success.

It is true that short courses in plastic surgery are being given to Army medical men at a few medical schools. The Manual of Maxillo-facial Surgery, so ably prepared by Ivy and Smith, will also contribute to better treatment of facial injuries. But these measures are not sufficient.

While the heads of general hospitals are authorized to assign reconstructive cases to a plastic surgeon if they see fit, they are not required to do so. It is left to their option whether to organize a service for plastic cases or do this work themselves.

It is no reflection on the skill of the general surgeons to say that few of them are equipped by training or temperament for plastic surgery which, in Blair's words, requires a "different mental make-up than . . . work in problems related to the special sense or the vital organs." As far back as 1926, Davis remarked that "it is a well-recognized fact that few general surgeons can do plastic work well. . . . "[3] The interests of these patients are better served when treatment is given by trained specialists than when they are looked after by the general surgical service.

With others familiar through actual military experience with the type of casualties we can expect to encounter, I believe that the Maxillo-facial Division should be expanded into a Division of Plastic Surgery, empowered to handle all injuries requiring plastic repair, whether located on the face and jaws, neck, trunk, or extremities.[4] The

[3] Davis, J. S. The story of plastic surgery. *Ann. Surg.*, June, 1941.

[4] Maliniac, J. W. Plastic surgery in war. *Tr. Ninth Ann. Meet. Am. Soc. Plastic & Reconstructive Surgery*, Chicago, October 25, 1940.

boundaries of plastic surgery are clearly set forth in Davis' definition: "Plastic surgery is that branch of general surgery which is distinctly formative or restorative. It deals with the reconstruction of injured, deformed or lost parts all over the body; with the re-establishment of function, and incidentally with the improvement of appearance."

A Division of Plastic Surgery must envisage three stages of treatment: early, intermediate, and late.

Even in the early treatment, given at front medical posts, where the saving of life is the first consideration, certain basic principles of plastic repair must be applied to prevent deformity and shorten the period of repair. The emergency measures taken in large burns and jaw fractures, to cite two types of wounds, may determine the course and final outcome of reconstruction. The front line surgeon should, therefore, have some knowledge of the fundamentals of plastic repair.

The second or intermediate stage of treament devolves mainly upon base and general hospitals. Here, infections are treated, tissue losses provisionally replaced, fractures of the mandible reduced and temporary prosthetic work done, with a view to preservation of function. Well organized subdivisions of plastic surgery, with qualified specialists in attendance, are indispensable at these hospitals.

For the long, final stages of repair, patients requiring extensive plastic reconstruction must be segregated in special plastic centers, headed by a general plastic surgeon.

The creation of a Division of Plastic Surgery on the scale envisaged would require the fullest possible utilization of qualified personnel in this field. This may make necessary the abrogation of present age limits. In medicine, experience contributes more to skill and judgment than in almost any other field. Many plastic surgeons who could do valuable work are prevented by prevailing age limits from placing their knowledge and ability at the country's service.

This numerical factor is particularly important in view of the many far-flung fronts in the present conflict. In the last war, we had a relatively short front in which available personnel could be concentrated. Today, our fronts extend over thousands of miles, necessitating a dispersal of medical facilities. Since the supply is necessarily limited, it is essential to call upon and utilize fully all qualified men.

I realize the enormous tasks which war has laid upon the military medical services and the difficulties which attend their current unprecedented expansion. Nevertheless, in view of the number of casualties which will require plastic reconstruction, I believe the organized plastic surgeons of the country, who are familiar with the problems involved, could render a great service by attempting to secure the establishment of an independent Division of Plastic Surgery, with status equal to the other surgical specialties, and to seek fuller utilization of qualified specialists in this field, regardless of age or other arbitrary limitations.

The experience of the last war, the development of plastic surgery since, the favorable experience with separate services for plastic surgery in most of the important civilian hospitals in the past two decades, the existence of a national qualifying board, all make possible a more efficient and comprehensive organization in this field than was possible in the last war, when none of these factors existed.

Sooner or later the indicated reforms will probably come. The sooner the better for the thousands of casualties who will need such service!

This situation is at once a challenge and an opportunity for the leaders in this field. The great bulk of casualties which may be expected have yet to arrive. There is still time to perfect a suitable system, but time is running short. Let us not be "too little and too late" with the proper organization to care for our wounded and return them as speedily as possible to normal peace time life.

JACQUES W. MALINIAC, M.D.

Original Articles

TRAUMATIC RUPTURE OF THE KIDNEY

PAYSON ADAMS, M.D.
Diplomate of the American Board of Urology
OMAHA, NEBRASKA

THE run of the mill injuries of the urinary tract often are quite symptomless and obscure when the seriously injured patient is first seen at the site of accident or on admission to the hospital. Urgent and more commanding symptoms of other accompanying injuries tend to divert one's attention from the more silent symptoms or signs of kidney, bladder or urethral injuries. Thus precious hours are often lost in directing treatment to the injuries of the urinary tract. Routine inspection of the urine in all accident cases, noting the presence or absence of blood, will usually prevent such disaster, for with few exceptions hematuria is present in injuries of the urinary tract. Without such routine examination, a comatose patient with skull fracture may die from unsuspected renal hemorrhage, or the patient with a fractured pelvis may go for many hours or days before rupture of the bladder or urethra is discovered.

Less frequently, serious kidney injuries are caused by quite insignificant trauma. In one instance, a fall from a golf bunker on the seventh hole caused the patient such little discomfort that he proceeded with the eighth and ninth holes. On reaching the club house, he noticed bloody urine. This patient had a seriously ruptured kidney. After hematuria has directed one's attention to the urinary tract, its origin is not difficult to determine. If and when the patient's condition warrants a more complete diagnosis, such procedures as *x*-ray, intravenous urography and cystoscopy may be carried out.

Uncomplicated rupture of the kidney of such severity that operation is considered is seen relatively infrequently and, therefore, no one surgeon sees a large number. A small group of seven patients seen by the author in the past two years, six of whom were operated upon, serve as a nucleus for study in preparing this report. Several other patients seen in earlier years are referred to in the text because of their interest, but are not included in the statistical outline. (Table 1.)

Mechanism of Injuries. The normal kidney may be ruptured by force exerted either from the front, side or back, by a blow, fall or crushing force. The degree of kidney damage bears no direct relationship to the degree of force applied but depends more on the way the force is applied and the position and condition of the kidney at the time. If the kidney has previously been decapsulated by operation, damage is relatively more severe than if the protective, fibrous capsule is present. In the presence of congenital renal abnormalities, rupture may occur more readily, notably in polycystic kidney disease. Rupture of a polycystic kidney occurred in one patient as a result of being struck in the side by a stream of water from a fire hose. Spontaneous perinephritic hematuria occurred in one patient due to rupture of an infarct associated with chronic glomerulonephritis. The force may act either directly on the kidney through the intact abdominal wall, or the kidney may be caught between the lower ribs in front and the resistant spine behind. With the kidney normally engorged with blood at the time of injury, the sudden, increased hydraulic pressure causes a bursting of the kidney. It is difficult to rupture a kidney postmortem when the kidney is devoid of blood.

TABLE I

BRIEF SUMMARY OF SEVEN SEVERELY RUPTURED KIDNEYS—NO DEATHS

No.	Age	Sex	Side	Cause	Previous Disease or Anomaly	Associated Injury	Hematuria	Urinary Extravasation	Perirenal Hematoma	Type of Kidney Injury	Operations after Injury	Operation	Postoperative Hospital Days	Complications
1	40	M.	Rt.	Horse kick	0	0	Massive	Yes	Large	Multiple complete fractures	2	Drainage	56	Persistent fistula healed 56 days postoperatively
2	15	M.	Lt.	Horse kick	0	0	Slight	Yes	Moderate	Multiple complete fractures	2	Nephrectomy	12	0
3	19	M.	Rt.	Horse kick	Bilateral double pelves and ureters	0	Moderate	Yes	Moderate	Single complete fracture	2	Drainage	12	0
4	11	M.	Lt.	Coasting	0	Ruptured spleen	Massive	Yes	Small	Multiple complete fractures	1	Kidney exploration and drainage Splenectomy	16	0
5	16	M.	Lt.	Merry go round	0	0	Moderate	Yes	Large	Single complete fracture	2	Nephrectomy	17	Pedicle hemorrhage; clamps left
6	18	M.	Lt.	Football	0	0	Moderate	?	Moderate	Nearly complete decapsulation by subcapsular hematoma	4	Decapsulation complete and drainage	10	0
7	38	M.	Rt.	Golf	0	0	Massive	No	Large	Questionable	0	No operation. Home 7 days after injury	..	0

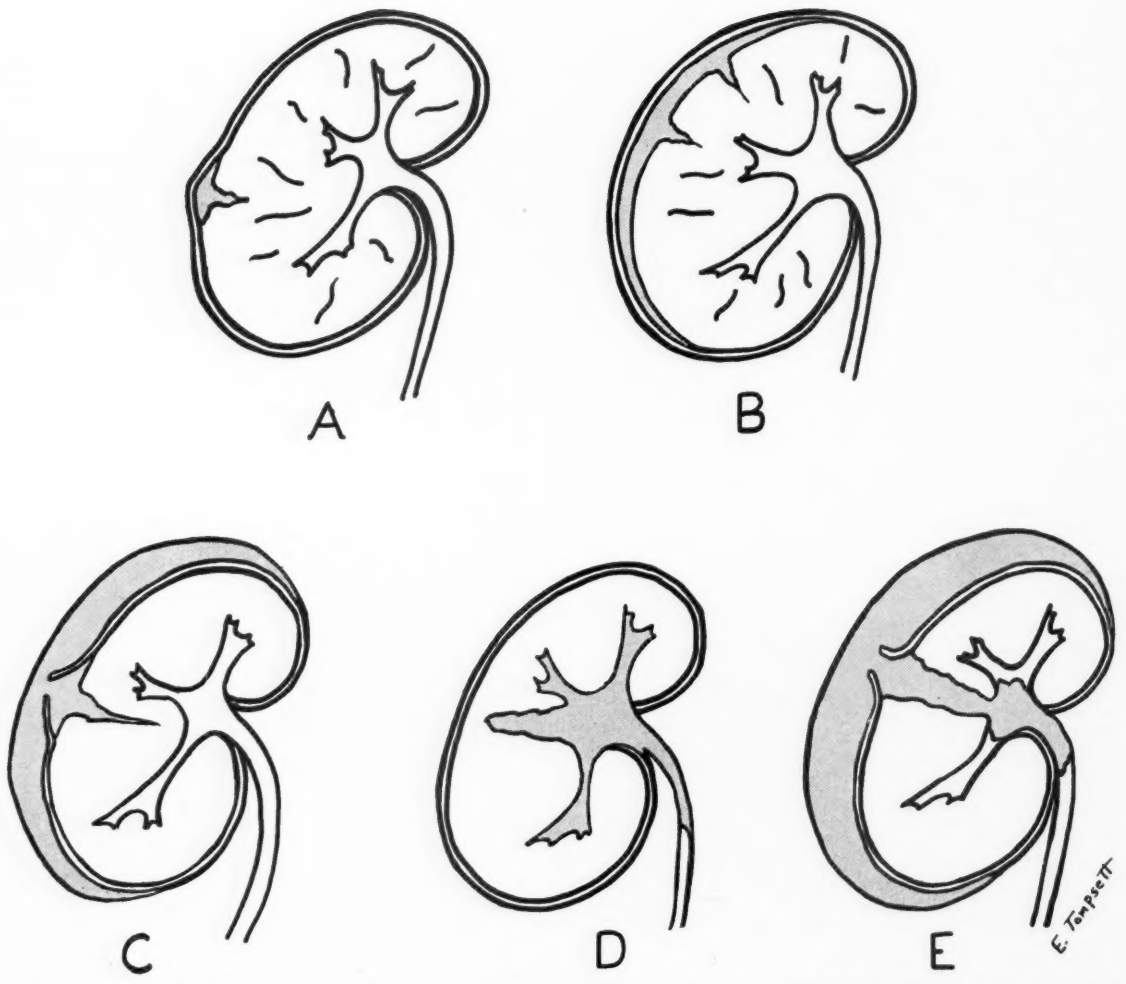


FIG. 1. Contused and fracture injuries of the kidney. A, contusion of parenchyma with small subcapsular hemorrhage; B, severe contusion with large subcapsular hemorrhage; C, incomplete fracture with laceration of the capsule and large perinephritic hematoma; D, incomplete fracture with rupture of the pelvis, allowing the pelvis to fill with blood; E, complete fracture with extravasation of both blood and urine into perinephritic tissue.

Classification. The appearance of the kidney at operation or autopsy depends upon the extent of injury. All renal injuries should fall into one of the three main divisions in the following, simple, practical, clinical classification. Figure 1 diagrammatically illustrates contused and fracture injuries of the kidney.

1. Contusions:
   a. Without subcapsular hematoma
      Mild contusion and slight tearing of the renal parenchyma not extending into the pelvis and without rupture of the renal capsule.
   b. With subcapsular hematoma
2. Fracture:
   a. Incomplete
      (1) Deep fissured fractures of the renal parenchyma and capsule not communicating with the renal pelvis. Therefore, hematuria is not marked and urine does not extravasate with blood into the perinephritic tissues.
      (2) Deep lacerations invading the pelvis but not involving the capsule. No perinephritic hematoma or extravasation of urine occurs but the hematuria is gross.
   b. Complete
      Involving parenchyma and both capsule and pelvis.
3. Tears of the renal vessels or ureter:
   Usually associated with other severe renal injuries but may occur alone. Internal hemorrhage and shock occur when the renal vessels are torn. Hematuria does not occur if there is no associated renal trauma or when the ureter is severed.

Diagnosis. A history of a blow in the flank followed with pain and hematuria indicates traumatic injury to the kidney. Young, healthy males are most vulnerable because of the active lives they lead. Of seven patients seen recently with uncomplicated rupture of the kidney, three resulted from horse kicks, a frequent cause in the rural areas. One patient fell from a merry-go-round, one fell from a golf bunker, a third suffered a flank injury due to a coasting accident, and the fourth was injured in a football game. While automobile accidents are a frequent cause, other associated injuries usually occur.

Examination of a patient with kidney injury usually demonstrates exquisite tenderness in the costovertebral angle, side and upper abdomen, and if perinephritic hematoma is present, a mass may be palpated in the region of the kidney although usually the patient is so tender in this area that examination is difficult and unsatisfactory. If the patient is distended, slight generalized abdominal tenderness is present.

Early, the patient may present evidence of shock, usually due more to trauma to the nerve plexuses near the kidney pedicle or the adrenal gland or to the kidney substance itself rather than to loss of blood. Shock occurring several hours later due to hemorrhage is manifested by progressive anemia, increase in the pulse rate, drop in blood pressure, restlessness, thirst and pallor. Occasionally, patients with severe fracture of the kidney present no early evidence of shock. As a matter of fact, many of these patients continue with their work or play for some hours or even days only to seek medical aid as secondary shock from hemorrhage occurs, or when symptoms of progressive anemia occur, or when pain from increasing perinephritic hematoma becomes severe.

Abdominal distention from reflex paralytic ileus may so dominate the picture that possible rupture of a viscus holds the center of attention. This is particularly true in those cases of renal injury without blood in the urine. Or if hematuria is present, the kidney injury may be considered simply a complication and not of paramount importance. Hemoperitoneum at once suggests some intraperitoneal injury but may be due to leakage of blood from the perinephritic space through a lacerated peritoneum. In one case, massive hemoperitoneum occurred in association with gross hematuria due to simultaneous rupture of the left kidney and spleen.

It is axiomatic that the presence or absence or amount of blood in the urine is no criterion to the existence of, or the degree of, renal injury. Hematuria is almost

always present when significant renal injury occurs, but obviously hematuria is absent when the ureter has been severed or when the renal vessels have been ruptured and the kidney spared from injury, or when the fracture line does not enter the renal pelvis. Should blood clots block the ureter, hematuria disappears. In complete fracture, the path of least resistance for the blood to follow is out through the ruptured cortex into the perinephritic space so that in such instances hematuria may be quite inconspicuous. This was true in one case in which there were multiple complete fractures of the kidney with one completely detached fragment. Sometimes there may be a period of renal suppression in which no urine is secreted by the injured kidney. Quite obviously then, hematuria may be absent or inconspicuous for various reasons but in fully 90 per cent of cases, hematuria is prominent and is usually more massive and persistent than that seen in rupture of the urethra or bladder.

Positive evidence of kidney rupture does not complete the diagnosis. Possible associated injuries to other organs deserve consideration and the actual extent of renal damage should be established in order that proper medical or surgical treatment may be carried out.

Abdominal *x*-ray, excretory urography, or cystoscopic examination and retrograde pyelography are helpful aids in completing the diagnosis after critical clinical evaluation. Any or all of these accessory aids may be indicated. *X*-ray of the abdomen is disappointing because often the renal areas are obscured by intestinal distention which is difficult, impossible or inadvisable to relieve with enemas, cathartics or drugs. It should always be obtained preliminary to excretory urography and has value in demonstrating associated skeletal fractures such as fracture of the lower ribs or transverse process of the upper lumbar vertebrae. It may give valuable evidence of air under the diaphragm diagnostic of ruptured viscus, multiple intestinal fluid levels suggestive of ileus from intestinal obstruction or ruptured viscus. In one case the splenic flexure of the large bowel and small intestinal coils in this area were displaced downward and inward which suggested rupture of the spleen. This was verified by operation. The size and outline of the kidneys frequently can be seen if not obscured by gaseous intestinal distention. A grossly enlarged kidney shadow indicates marked kidney damage or perinephritic hematoma.

Excretory urography is the most valuable single accessory aid in diagnosis. The kidneys are much better visualized than on the plain film because the kidney tubules are filled with the contrast media and, therefore, the renal outlines can better be distinguished from the surrounding perinephritic structures. Often the severely damaged portion of the kidney does not excrete the media but usually the remaining renal tissue does, so that the pelvis and some of the calyces show in the films. Irregular filling and bizarre arrangement of the calyces are usually seen in excretory pyelograms when rupture of the kidney is present. Occasionally, the injured kidney fails to excrete the contrast media which is in itself diagnostic of severe kidney injury but is disappointing to the physician for no pyelogram is obtained and urinary extravasation cannot be demonstrated. If the media is excreted, there is no question that extravasation is present when a small concentrated collection of media is seen outside the kidney or ureteral areas. (Fig. 2.) When there are multiple renal fractures and a large perirenal hematoma, the urine and contrast media escape so rapidly and diffuse so quickly and widely that the extravasation is demonstrated with difficulty as a slight generalized increase in density in the perinephritic region. (Fig. 3.)

Cystoscopic examination may be indicated when the exact source of the hematuria cannot readily be demonstrated. Rupture of the urethra and bladder can be ruled out in this way although this is not specifically recommended. Observation of blood coming from a urethral orifice points to the corresponding kidney as the

source. Ureteral catheterization may be desirable if the ureter has become occluded by blood clots.

bed rest, sedation and general supportive measures. The patient should be kept in bed for a week or ten days to minimize the danger of late hemorrhage. He should restrict his activities for another week or two because of the danger of hemorrhage due to secondary infection which may occur as late as one month after injury. Hematuria is no guide to the degree of kidney damage. Often hematuria of the frankest sort is seen in minor renal contusions which promptly subsides in a few hours or days, whereas no blood is seen in the urine in severe renal injuries if the ureter is severed or when the ureter becomes occluded with blood clots.

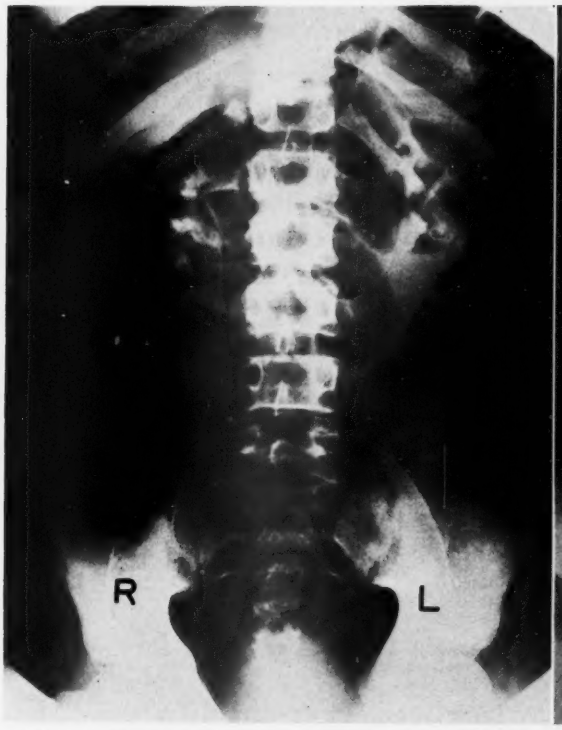


Fig. 2. Excretory urogram shows unmistakable extravasation of contrast medium into the perinephritic tissue in the region of the left renal pelvis. At operation the lower half of the kidney was almost completely detached from the upper half and the lower pole was completely severed and found lying free two inches below. Nephrectomy was done. Note the intestinal gaseous distention so frequently observed.

Fig. 3. Excretory urogram shows a zone of increased density surrounding the right kidney interpreted as extravasation of contrast medium into the perinephritic space. Operation demonstrated a huge perinephritic hematoma and multiple fractures of the parenchyma of the upper pole of the right kidney. The kidney was not removed.

When the excretory urogram is not diagnostic, one is justified in obtaining a retrograde pyelogram which readily demonstrates extravasation when present, and gives a clearer outline of the renal pelvis and calyces than most excretory pyelograms. (Fig. 4.) Since secondary renal or perinephritic infection may follow ureteral catheterization and retrograde pyelography, the danger should be emphasized and the procedure carried out in a strictly aseptic manner. When extravasation is suspected, sodium iodide should not be used because of the irritating nature of the drug. Drugs used for excretory urography can be used half strength for retrograde pyelograms with safety.

Treatment. The vast majority of minor renal contusions heal spontaneously with

The patient with severe renal injury deserves meticulous observation. He should be kept at rest and comfortable by adequate sedation. Shock must be actively treated. A careful watch must be kept on the pulse and blood pressure. Clinical

indications for immediate urgent operation are persistent hemorrhage and sepsis. Hemorrhage is manifested by progressive

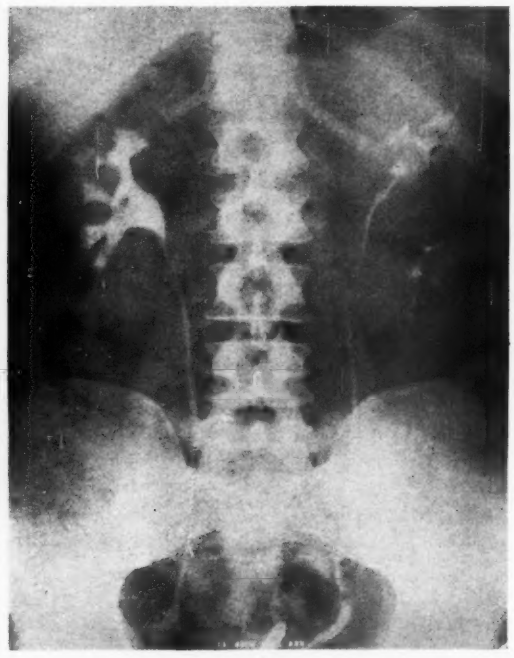


Fig. 4. Retrograde pyelogram demonstrates a double left renal pelvis with extravasation of the contrast medium from the upper pelvis. The excretory urogram failed to demonstrate satisfactorily the extravasation. At operation for drainage of an infected perinephritic hematoma, the kidney was found to be polycystic.

increase in the pulse rate or decrease in blood pressure, anemia, appearance of or increase in the size of a tumor in the renal area, and the appearance of free fluid in the abdomen. Sepsis from urinary extravasation is suggested by moderate or high elevation of temperature.

Elective conservative or radical surgery may be indicated on purely clinical observation but usually depends on more precise *x*-ray and pyelographic evidence. If each case can be placed in one of the three categories enumerated under classification, surgical or medical treatment becomes clear.

The small subcapsular hematomas absorb spontaneously. Surgery is indicated in large subcapsular hematomas and in those which lift the entire capsule from the parenchyma. Conservative surgery consisting of splitting the renal capsule or decapsulation should relieve severe renal pain by releasing increased intracapsular tension and will minimize cicatrization incident to the healing process.

The smaller capsular and parenchymal tears in which the fracture line is narrow and does not enter the renal pelvis will heal spontaneously. Large hematomas absorb slowly and while surgical drainage is not specifically recommended if urinary extravasation has not occurred, it is quite effective treatment when other conditions warrant surgical renal exploration. If minor incomplete fractures involve the parenchyma and pelvis but not the capsule and no subcapsular hemorrhage occurs, operation is not indicated although in such cases the hematuria may be profuse and operation may be indicated on this ground.

Complete fracture involves the pelvis, parenchyma and capsule and permits perinephritic urinary extravasation. Surgical exploration is always indicated after control of primary shock and before secondary shock from hemorrhage is manifest. In such cases the perinephritic hematoma is removed or drained, the kidney is inspected and if injury is not too extensive, the separated fragments may be approximated by suture with ribbon catgut as recommended by Lowsley. If the capsule is not intact, this method of repair is not feasible. Mattress suture with ordinary catgut always causes some renal parenchymal damage. If hemorrhage is active, a bit of perinephritic fat held in the fracture line with ribbon gut is an effective hemostatic. If there is no active hemorrhage and if the fragments are only slightly separated, simple drainage without repair will be sufficient. Any bloodless or devitalized kidney tissue must be removed.

When laceration of the renal vessels occurs early, renal pedicle ligature and nephrectomy is life saving. Ureteral anastomosis of the severed ureter is feasible but quite theoretical for usually associated extensive renal damage requires nephrectomy. It is desirable to inspect the upper ureter in all cases in which the injured kidney is repaired and left *in situ*.

The most logical approach to the kidney is through the loin, exposing the hematoma first and freeing the kidney extraperitoneally. When the spleen is thought to be involved it can readily be inspected through a left lumbar kidney incision and removed through this approach as was done in one case. A transperitoneal approach is not desirable but should rupture of the kidney be found during intra-abdominal exploration, renal pedicle ligature is readily accomplished followed by transperitoneal nephrectomy. Conservative renal surgical maneuvers using the transperitoneal approach are not desirable.

Single or multiple Penrose drains should be inserted and brought out the posterior angle of the incision when extravasation or hematoma is present.

SEQUELAE

The traumatized kidney always heals by fibrosis and the injured parenchyma is replaced by cicatricial tissue. The greater the extent of injury and the more widely the fragments are separated, the more cicatrization occurs. Therefore, there is always some loss of functioning renal parenchyma and frequently one or more of the major calyces is obliterated. If perinephritic or subcapsular hemorrhage is not absorbed, organization occurs which causes thickening of the fatty or true capsule and this may compress the renal parenchyma. This may be the explanation of renal hypertension occurring after renal injury.

Infection must be anticipated when extravasation of urine occurs. Late perinephritic abscess from infected perinephritic hematoma is serious and can be avoided by early operation. Prompt drainage when perinephritic abscess does occur is desirable. Renal infection and late chronic pyelonephritis frequently follow kidney injury with extravasation. Renal stones are said to occur relatively more frequently in traumatized kidneys. Hydronephrosis may occur as a result of upper ureteral stricture resulting from perirureteritis from infection.

Spontaneous or operative evacuation of infected extravasated urine may result in a persistent lumbar fistula if normal ureteral urinary flow is partially or totally impaired by ureteral stricture. Appropriate early operation should minimize this hazard but if it occurs, secondary plastic operation may be necessary designed to remove the ureteral obstruction.

SUMMARY

1. Seven recent severely ruptured kidneys are analyzed. Six had early operation. One had an associated rupture of the spleen. There were no deaths.

2. Early operation is stressed, but only after primary shock from trauma to nerve plexuses about the kidney pedicle is controlled and before secondary shock from hemorrhage occurs.

3. Preoperative evidence of urinary extravasation is demonstrated satisfactorily by intravenous urography. Retrograde urography is thought to be unnecessary and undesirable except when additional information is essential.

4. Urinary extravasation always indicates severe injury of the kidney and is felt to be a specific indication for operation.

5. The presence or absence and the degree of hematuria are no criteria of the severity of renal damage.

REFERENCES

1. ADAMS, P. S. and BOWERS, W. F. Simultaneous rupture of left kidney and spleen. *Nebraska M. J.*, 25: 417, 1940.
2. FARMAN, FRANKLIN. Diagnostic and operative factors in traumatic rupture of the kidney. *J. A. M. A.*, 114: 207–216, 1940.
3. LOWSLEY, OSWALD S. and MENNING, JOSEPH H. Treatment of rupture of the kidney. *J. Urol.*, 45: 253–271, 1941.
4. PEACOCK, A. H. Rupture of the kidney. *West. J. Surg.*, 48: 129–134, 1940.
5. PRATHER, GEORGE C. Traumatic conditions of the kidney. *J. A. M. A.*, 114: 207–217, 1940.
6. RITVO, MAX and STEARNS, DAVID B. Roentgen diagnosis of contusions of the kidney. *J. A. M. A.*, 109: 1101–1105, 1937.
7. SARGEN, JAMES C. Injuries of the kidney. *J. A. M. A.*, 115: 822–826, 1940.
8. STIRLING, W. C. and LANDS, A. M. Experimental studies of injuries to the kidney. *J. Urol.*, 37: 466–479, 1937.
9. TWINEM, FRANCIS PATTEN. Polycystic kidneys with bilateral perinephritic abscesses: bilateral operation. *J. A. M. A.*, 106: 206–207, 1936.

WAR WOUNDS*

J. EASTMAN SHEEHAN, M.D.
Professor of Plastic Reparative Surgery, New York Polyclinic Medical School and Hospital
NEW YORK, NEW YORK

ANY wound sustained in war might have its counterpart in injury to the body in civil conditions. War wounds, however, tend to fall into certain categories. In each of these they are produced in numbers that have no parallel in times of peace. War is designed in terms of violence. In modern warfare, the utmost resources of physical science have been drawn upon to produce mechanical agents of destruction, each more potent than the last. The human body, which has to endure this violence, is not susceptible of corresponding change. It is no better equipped to offer resistance to the impact of the explosive shell or the aerial bomb than it was when men fought only with arrows and with swords.

Medical science has had imposed upon it the task of rescuing the individual from the effects of injuries visited upon him with increased severity by the advancement of physical science.

The human body, consisting of soft tissues on a framework of bone, is invaded by bullets from a rifle more than two miles away and that travel toward him at the speed of sound; or its tissues are penetrated by and give lodging to particles of great variety from the bursting cover of a high explosive shell; or the organs within its lightly constructed cavities may be compressed by the detonation of bombs dropped from the sky; or the tissues may be crushed by contact with tons of steel in motion, or by the beams or masonry of falling walls. Bones are broken, vessels are penetrated, the body covering is burned; and the bodies thus weakened are further invaded by hosts of enemies that are invisible but actively destructive.

Surgery in war is directed imperatively to coping with these disasters. In one particular the human body is on a different plane from the agents of its destruction. A damaged airplane, a damaged tank, can be repaired from without. The body is the chief contributor to its own repair. The surgeon's problems are how to keep it alive; how to enable it to support its injuries; how to protect it against invasion from invisible enemies; how to enable it to resume its functions; how, in many instances, to preserve its appearance. For the solution of all these problems the surgeon looks first to what the body can do for itself, and next to affording such aid as will give it the best chance to do so successfully.

It follows that the organization for the care of war wounds is in some respects standardized, in others, infinitely various. Wounds involve loss of blood, and without an adequate supply of blood in circulation the body is incapable of offering effective resistance to the outrage to which it has been subjected. Hence, the first item of routine is to replenish the blood volume. Hence, the first procedure incidental to war surgery is the provision of blood and of plasma, now available on a scale never hitherto contemplated, to make possible the recovery from "shock."

Next, the body's equipment of aids to its recovery is impaired by pain. Hence, morphia may be given at the time of greatest peril. Rest for the disturbed tissues is a matter for later concern. Cold has an adverse influence, and the answer is in the provision of warmth. Fear and anxiety are also retarding influences.

Time is a factor of high importance. The body itself offers the first resistance to

* Read at a Meeting of the Staff of St. Mary's Hospital, London, December, 1942.

assaults upon it, but this resistance is good only for the first few hours. Organization for the care of the war wounded is, therefore, keyed to the earliest possible first and secondary care, and to the minimum of delay in clearing away contamination. How to inhibit bacterial invasion and how best to control and eliminate infection are subjects that command the widest knowledge and the highest skill. Chemotherapy, in many forms, enters into this phase on a scale commensurate with the aggregate of the injuries and their infinite variety.

A self service of which the body is incapable, its release from tissues that have been devitalized and are a menace to its safety and the extrusion of equally menacing foreign bodies, becomes the first actual, surgical service in many instances. How best to cleanse a wound; how best to keep it clean and give the injured tissues the rest to which they are entitled and which they must have if they are to react as desired; how to prevent infection or to control it; how best to lead up to the stage of decisive achievement in healing—these constitute the main body of war surgery.

It goes without saying that war wounds are of such variety as to command classification, at or soon after the first attentions, into all the divisions of specialized surgery. The head, the thorax, the abdomen, the great vessels, the limbs and joints, all demand the benefit of such specialized experience. The same is true of the replacement of lost tissues, notably that replacement of skin following burns, which aerial bombing and other factors of the mechanical aspects of this war have produced on a scale for which there is no precedent. Moreover, since the wounds in this war tend to be multiple, and therefore diverse, cooperation between specialists, e.g., between orthopedic and plastic surgeons, tends to become a feature of every center of surgical repair.

Tissue Destruction and Contamination. While the violence of the wound has induced conditions of shock which may have affected not only the blood circulation but any or all of the vital organs of the body, two other effects have been produced at the area of actual contact. One is that the force exerted by the missile may so completely disrupt the tissue with which it comes in contact as to render it incapable of resuscitation. Fibers in a muscle are forced apart. Having no blood or nerve supply left, they do not bleed or contract. Into the spaces formed by this disruption there is an outpouring of lymph. Edema follows. The mass becomes a medium for anerobic infection. The other condition is the contamination of the area traversed by the missile; dirt, morsels of clothing or other foreign bodies lodge in the wound, bearing with them the bacteria of infection.

In the one case, the dead tissue is to be cut away, without loss of time, clear back to the line at which the disruption ends. In the other case, with equal promptness, elements of contamination are to be cleared away and the wound made clean.

Traumatic Agencies of War. The severity of the wounds is to be inferred from the nature of the agencies that inflict them. In the main these are bullets, shells and bombs. There were these in the last war and in every war of recent times. To the classification hitherto existing are now added the tank and the airplane, both driven by highly inflammable fuel, giving to the casualties a proportion of burn injuries greater than in any previous experience. Moreover, the airplane, dropping explosive and incendiary bombs, has brought the civilian populations, behind the lines of battle, within the purview of the war wounded.

The bullet from a rifle now has a range of two and a quarter miles. It starts at a speed of 2,800 feet a second. Forty years ago the rifle bullet drilled a clean wound through flesh. That is seldom the case now, except at parts of the trajectory. Oscillation is caused by air pressure at the highest velocity, and the bullet may turn completely when nearly spent. The machine gun and the submachine gun have muzzle velocities of 1,000 feet per second or more.

The impact of any of these missiles disrupts and devitalizes the tissues with which they are in immediate contact. The wounds inflicted are of great variety: a clean drill, small entry and large exit wound and vice versa, shattering of the tissues at the surface or internally, or the bullet may come to rest in the tissues.

High explosive shells, covered with thick iron casing, which scatters at high speed when the shell breaks in particles of all sizes and weights, produce wounds that are the worst seen in warfare. Hand grenades, being of similar material, and which may be loaded with bits of metal, also make missiles of the earth and stones where they strike.

All of these missiles, besides being destructive to tissues, carry in with them particles of clothing, and the clothing possibly being dirty and the bearer of various forms of bacteria, foci of infection are simultaneously established.

The aerial bomb, on the other hand, has a soft coating of aluminum alloy. This covering, shattered by explosion to sizes varying from pinpoint to thumb nail in size, and which travel, for the first fifty feet, at 5,000 feet a second, at which speed they are of incandescent heat, have the most devastating effect on the soft media of human tissues. There is a tendency to multiplicity of wounds. These may be minute at the surface and of vast proportions within. Every surface wound demands examination to determine the internal effects.

Fire and oil bombs, incidental to aerial bombing, produce appalling burns, often with chemical erosion. As the first attack is on uncovered parts, extensive edema, with the face sometimes swollen to thrice its natural size, is characteristic; and the liberated gases produce gross lesions. The use of flame throwers adds to the aggregate of burns, as do the catastrophes encountered by planes in combat whose fuel takes fire.

Where so much dependence is placed on the destructive power of explosives, there is certain to be injury from compression as well as from actual wounds. The lungs and other organs may be subjected to grievous injury. This happens, notably, in connection with the explosion of ground mines, which constitute part of the answer to motorized aggressive warfare. In air attacks on cities, the young are the most numerous victims of compression.

The detonation of high explosives in a confined space, characteristic in the bombing of towns, is more disastrous, in this matter of compression, than was the explosion of projectiles in the open field in former wars. Many are killed without being wounded. The clothes are torn off others. There may be hemorrhages in the air passages and in the lungs. The symptoms are diminished movement of the diaphragm, fullness of the lower chest, signs of lobar pneumonia and pyrexia, extreme respiratory dyspnea, pain in the chest, even cyanosis. There may be rapid development of severe shock. The nervous system, the ear drums and the intestines may be affected. Abdominal pain is an invitation to "look and see." In any exploration, it is best to avoid using other than local anesthesia.

Another by-product of aerial warfare on towns is the number of injuries from being crushed for long periods under falling walls or timbers. Uremia and anuria command immediate attention.

What is notable about the present war, as compared with others, is the multiplicity of wounds that may be received by the same person at the same time. Attack from above as well as from in front, together with the incidence of dispersal of fragments after explosion, produces a reaction that has caused this to be called "the war of the crouching man." Wounds in the back are common. To know the position of the patient when the wound was received may be the best guide to determine the route of the missile along the tissues or across them.

The Time Factor. In any planning for the healing of war wounds, the first importance is to be assigned to the time factor.

The reason for this is that the body instantly concentrates its protective forces upon the area in which the insult has been received. The effectiveness of this protection diminishes rapidly. It is at its best in the first few hours. It must either be sustained at that level or be brought back to it. Once there is a breach of the body's covering, the way is open for invasion of bacteria. From that instant the fight is on. The body takes the aggressive, sending out to the exposed surface liquidbearing cells for the construction of a cover and cells to combat the anticipated invasion. War wounds are apt to be contaminated, for example, by dirt carried in with the morsels of clothing. It is calculated that there is a margin of four to six hours, hardly ever more than twelve, within which, if contamination can be removed, infection may be averted. After twelve hours clean healing is not to be looked for. The lucky patient is the one who has his wounds cleaned quickly after they are inflicted. Plans for transportation of the wounded are made with this in view, but the incidence of battle generally operates against advantage being taken of the time lag. The patient and the surgeon enter upon the combat with the invisible enemy, and the weaker the patient is, the more assiduous the surgeon must be in restoring his capacity for resistance. It has been said, "His task must be to co-operate with nature, and direct his actions so as to imitate nature's own methods of protection."

Blood Supply the Critical Factor. The essential explanation of differences between early and late attention to wounds lies in the fact that the process of resistance reacts upon the blood supply, by which the equilibrium of security is sustained. The volume of fluid within the circulatory system is a relatively small part of the fluid content of the body, but it is in immediate contact, at the capillaries, with the all-pervading lymph, and therefore with the cells invested by the lymph. When the fluids rush to the injured parts as exudates and the fluid reservoir is progressively drained, the liquid content of the blood stream seeps through the capillaries to replace the lymph that is thus withdrawn. Since the liquid of the arterial blood stream thus tends to be withdrawn from the normal course of return through the veins, there is reduction of the volume to be oxidized and consequent concentration of hemoglobin. The nice balance of the capillaries is disturbed, and through these more than normally permeable endings the drain continues. Nature's capacity to contribute to healing by first intention is impaired by the inadequacy of the blood supply, whether the reduced volume is due to hemorrhage or to withdrawal from the system of the plasma fluid and the proteins it holds in solution.

At the outset, the failure of the venous return is a threat to the life of the patient, greater or less according to its degree. Of this the blood pressure is the index. Restoration of blood volume, with normal hemoglobin concentration, is essential, in the first place, to save the life of the patient. It is equally essential in assuring the blood supply necessary both for healing, if there is no infection, and for combatting infection if infection is declared.

The availability of blood plasma in the period of "shock" and afterward is what gives the wounded now a much better chance than the wounded had in any other war.

Blood Transfusion. Where the depletion of the blood volume is due to hemorrhage, replacement of the loss with whole blood has always been considered desirable. In war conditions this is difficult. If direct transfusion from donor to recipient can be arranged, there is the all important matter of matching types of blood. In the best conditions this means delay. Error in matching may produce reactions that deprive the procedure of the expected advantages. Again, while it is possible to have citrated blood at hand, the probability is lessened in that it tends to hemolysis when transported. Fifteen days from the time it is taken is an outside limit. Actually, if it has not been used in from

two to three days the plasma liquid is removed under a process designed to insure a sterile product, from which the hemoglobin and some other cells have been precipitated, and in which the blood proteins are held in solution. This continues effective for use over a much longer period. By eliminating the water and keeping the residue in a dry, desiccated form, it may be sent anywhere, in any quantity and kept indefinitely, and be administered in a distilled water solution. Again, the plasma may be frozen, kept in a refrigerator and thawed when it is to be used.

It is evident that, if the results that might be obtained by the transfusion of whole blood can be in large measure attained by the employment of desiccated plasma, and the plasma is on hand, while the whole blood transfusion is invested with delay and difficulty, it is the plasma that will dominate in the treatment of war wounds both on land and at sea. Wounded men on a war ship must be transferred to a hospital ship. Wounded soldiers must be carried by stretcher, by ambulance and then by train to some distant point. Both involve delay and the time lag operates progressively against the patient.

Plasma. Substitution of blood plasma for whole blood in transfusion has been under experiment for twenty years, but it was not until the outbreak of the war in 1939 that the change over was made on the grand scale which has had, as one result, the possession by any surgeon in his own office of the materials necessary for such infusion for use at a moment's notice.

Once it was established that the purpose would be as well served by plasma as by whole blood, the time element dominated the situation. In any condition, the time spent in obtaining the necessary Wassermann-negative and compatible donor could be the cause of fatality. In war conditions, with shock and depleted blood volume a matter of hours or even minutes, and a multitude of cases to be treated, delay could not be contemplated, if there was an alternative.

The preference for plasma, moreover, strikes deeper than that. It is not, as might be assumed, second choice, as compared with whole blood. With whole blood the emphasis is on the red corpuscles, and it is now perceived that, even in relatively severe hemorrhage, loss of red cells is not the important matter. There are enough left to go on with, and their replacement can be counted upon. The loss of proteins and of the liquid holding them in solution, from the blood stream, is of much wider significance.

In trauma, loss of blood, fear and cold induce hyperactivity of the sympathetic nervous system. There is, perhaps, most notably in extensive burns, a rush toward the area of injury of exudation of fluid with high protein concentration. This is the first effort made by the system in the process of healing. The sympathetic nervous system operates to assist in this flow, and in doing so, to increase the permeability of the blood capillaries. Through these openings even red cells may pass out into the extracellular interstices, instead of being retained in the circulation. The principal drain is, however, of the protein bearing fluid, rushing to the work of cellular repair and regeneration which cannot take place without certain essential amino-acids. As this loss becomes progressive, there is a reduction of the colloidal osmotic pressure of the remaining blood, which thus is rendered unable to draw on the extravascular reserves of fluid and so to replenish the diminished volume within the vascular bed.

Whether there is more or less fluid in the veins and arteries, or a higher or lower red cell count, is not, of itself, the important matter. The battle front is in the cells, which are impaired when oxidation fails, as it does when the accustomed amount of blood is no longer present in the circulation and the blood volume is inadequate to the field to be covered.

While liquid volume can be restored by the addition of isotonic solution, any gain is only temporary. The solution does not replace the protein carrying plasma liquid,

and since it does not belong, it is soon excreted. When, on the contrary, the blood proteins available in desiccated plasma are given in sterile water, in two or three times the normal concentration, not only does the solution replenish the blood volume but the demand of the surplus proteins for liquid to reduce their concentration, actually reverses the tide, drawing back fluid from the tissue spaces into the vascular channels. This may take time, but when it happens it ends the imbalance that accounts for what is conveniently called shock.

Two comparisons serve to emphasize the separate importance of the protein bearing plasma liquid as a constituent of the circulating blood. One is the failure of isotonic solution to replace it. The other is that while in whole blood transfusion, the red cells of noncompatible donor blood may be destroyed by the plasma of the recipient, transfused plasma does not destroy cells of the recipient, a difference almost conclusive of preference for plasma infusion. When the liquid tide turns toward the vascular bed for adjustment of protein concentration, it draws back into the blood any red corpuscles that had been washed into the extracellular spaces. Nor does the return of the blood's capacity to restore oxidation at the cells conclude the chapter. The distorted ratios of sodium and potassium within the cells and outside them also find adjustment. Finally, there comes that saturation of reserves of protein in the body that is of great importance in relation to recovery from infection.

The plasma bank, offshoot of the blood bank, called into being by the war and developed on a scale without parallel in the history of medicine, may be said to have been the means of restoring to the body, after wound or burn trauma, the capacity for healing and for more effective resistance to infection. Therein lies almost the whole difference between the direction surgery has taken in this war and the surgery incidental to all former conflicts.

Infection. The skin is the protector of the body against invasion by the organisms of infection. Any breach of its continuity is an invitation to such an invasion and any of these organisms may be found in any wound. The immediate response of the body is to set up a protective barrier at the part thus exposed. The effectiveness of that protection depends upon the adequacy of the blood supply. A fibrinous, vascular, granulation tissue is formed outward from the surface. There is activity by the phagocyte cells in this tissue, and the blood and fluids which continue to be directed to the tissue in the period of growth are endowed with bactericidal power. The body applies its resources to restoring the equilibrium that has been disturbed. The invasive bacteria oppose that restoration. The fight is between the patient and the invisible enemies.

It is obvious, therefore, that the rôle of protein bearing plasma, important as it is in meeting the "shock" emergency by the replenishment of the depleted blood volume, is of even greater significance in equipping the blood stream for major effectiveness in the continuing process of healing. It has provided the kind of aid that is indispensible to the control of infection. Being without it in other wars, surgeons had to make the best of minor factors, such as antiseptics, which proved inadequate to the purpose. With a more dependable blood supply, the tendency has been to discard the antiseptics, thus eliminating such harmful action upon the granulation crust as had to be tolerated in the earlier conditions. Decisive, in this sense, has been the abandonment of the tannic acid method. What the formation of a crust by this method did to slow up the fluid exudations, and so let the system recover, is now done from within the system; so that, if there are areas of infection, they are no longer concealed by a crust.

In the nature of things, wound areas are exposed to a variety of infections. Some enter with foreign bodies, as with bits of clothing. If the clothing is dirty, it may bring in tetanus. Muscles devitalized by impact furnish a favorable medium for gas

forming anaerobes, the ensuing necrosis conducing, if not dealt with in time, to the putrifaction and liquefaction that characterize gas gangrene. The pyogenic aerobes and the sporing anaerobes, between them, threaten pus infection, gas gangrene and tetanus, three formidable opponents of healing and health.

In the field of pyogenic infection the most to be dreaded is Streptococcus pyogenes, since if it gains access to the wound it may invade the tissues before the defensive reaction has begun. If the infection begins after granulation has started, it may go unnoticed except under bacteriological examination. If neglected, it may set up toxemia, and a septic arthritis would be consistent with its affinity for joints. This emphas zes the importance of close co-operation between the surgeon and the laboratory during the period of effort to control infection, if one cannot prevent bacterial invasion.

Staphylococcus aureus may be considered the next most menacing, since, if it invades the tissues, it may set up a subacute pyemia or even a fulminating septicemia. Staphylococcal infection may give rise to metastatic abscesses in lungs, kidneys, brain or heart.

Bacillus proteus and Bacillus pyocyaneus are less dangerous, but they spread easily and as they compel interest in themselves by sight and smell, may mask the presence of more pathogenic bacteria. Also they are capable of spoiling a good skin graft if left below it.

Of the sporing anaerobes or clostridia, Clostridium welchii is more frequently encountered than the others, is more toxigenic than invasive; Clostridium oedematiens is mainly toxigenic; and Vibrion septique is both. These anaerobes frequently are isolated from wounds not affected with gas gangrene, as is Clostridium sporogenes which is hard to separate from the more pathogenic clostridia.

The sporing anaerobes, including tetanus, appeared in wounds received on battle fronts of highly cultivated territories. They were present in the soil and the soil was present in garments and on the skin.

It is the anaerobic spore bearers that first contaminate war wounds and are, therefore, if not promptly cleared away, the agents of primary infection. The streptococcal infections are secondary, in the sense that they are of later occurrence, but it is they that are responsible for septicemia, pulmonary complications, joint infections, prolonged invalidism and loss of function. It does not help matters that they too often are introduced by those who care for the patient in transit and in the hospital.

BURNS AS WAR WOUNDS

J. EASTMAN SHEEHAN, M.D.
Professor of Plastic Reparative Surgery, New York Polyclinic Medical School and Hospital
NEW YORK, NEW YORK

BOTH actually and proportionately there are more burns in this war than in any war that preceded it. It is a war made with machines driven by oil or gasoline, ships, tanks and airplanes. Men operating these are exposed to burns when the fuel on which they depend is set afire. The plane has the predominant rôle in the war, so far as burns are concerned. The pilots are themselves exposed to sudden bursts of flame in the air or on the ground. Planes are sent to attack tanks, and if they succeed there will be burns for the men shut up in the tanks. Planes are sent to drop explosives on warships, and may blow up the magazine or set fire to the fuel. Those in range of the flames, as they may be even when in the water, get burned. Planes drop explosive bombs on buildings and the buildings burn. Those in or near them do not always escape the flames. Then there are the bombs that are primarily designed to be incendiary, rather than shattering. Humans do not escape their attention. Burns from flame, cordite burns, phosphorous burns, electric burns, burns by chemicals, the airplane contributes to multiplication of all of them. Nor is the exchange of such injuries restricted to those in the opposing forces. The airplane has brought the civilian populations of the contending countries within the range of burn infliction.

Nor do numbers tell the whole story. A burn may affect a small surface, or it may injure a tenth, a quarter or a third of the skin covering of the body. It may only inflame the outer layers, or it may destroy the skin in its full depths, tear away sections of it, and even invade the soft tissues, tendons, vessels and nerves it overlies and protects. We speak of three degrees of burns but the differences account as readily for six.

All burn problems have one factor in common. Where there is loss of the skin cover, whether the amount of such loss be great or little, the part denuded must be covered by skin. Treatment of a burn should be consciously directed toward the ultimate replacement. When it is ready for that stage it should be under immediate direction of the surgeon who is to effect the replacement, and he, wherever possible, should be one whose experience and acquired skill offer the best warranty of success and satisfaction. The ideal situation is that in which the competent surgeon directs the preparation in all its phases. If numbers render that unattainable, as in war they may, patients should be assigned, in the later stage, to a center for replacement, and as soon as practicable after the injury, sent to centers devoted wholly to those suffering from burns.

In comparing the treatment of burns in the present war to that of other wars and of civilian practice, there are two features of outstanding interest and importance that are new. One is the availability of plasma as an adjunct in control of the "shock" that results from severe injury. The other is the use of the sulfonamides and some other preparations in the control of infection. Each has had an influence on current practice that can be properly described as revolutionary. In combination, they have displaced that tannic acid coagulation which was standard practice when the war began, and have led to skin grafting being set for a few weeks after the injury, instead of accepting the delays that in many instances have had disastrous results.

The plasma bank, as we now know it, did not exist before 1939. Sulfanilamide spraying of open wound surfaces, including burns, dates only from the civil war in Spain. It fell to my lot to be the first, as far

as I know, to apply sulfanilamide to the control of infection in war wounds.

When I accepted an invitation to organize a service for the wounded in that war, there was no available supply of tannic acid or silver. I did have at my command an ample supply of magnesium sulfate, and also, through the friendly co-operation of the Winthrop Chemical Company, a supply, for internal administration, of neo-prontosil and neo-prontolyn. In 1939, I wrote an account of my experience in Spain, including what probably is the first record of the use of sulfanilamide as a surface dressing to combat infection in war wounds, many of which were burns.

Quite remarkable success was attained in control of infection, and, there being no tannic acid crust to make for delay, the natural progress was from a clean wound to early skin grafting. I do not disguise the satisfaction there was in finding, late in 1942, that the method I adopted in face of difficulties some years earlier was being given the widest application in British war hospitals, to the practically complete exclusion of the tannic acid method.

Whatever may have conduced to acceptance of the view that a burn wound can be skin grafted in a few weeks, the fact itself is of the utmost importance. How disastrous delay may prove to be was illustrated by a case recently referred to me, that of a young man, whose hands were badly burned in one of the great steel mills more than a year before I saw him. The utmost function of which his hands were capable was an inadequate approach by the thumb and index finger of each hand. Hypertension at the knuckle joints, ankylosis of the others, immobile flexion, and distortion, all are to be accounted for by the contractures resulting from leaving the burned skin in place, whereas if replacement had been early, after-treatment with replacement in prospect, this disfunction might have been averted.

Decision on a matter of such importance turns, of course, upon accurate estimation of both the primary and the secondary injuries caused by a burn.

First, there is pain. For this there must be relief, and for that relief morphia is administered. Veterans in surgery do not shrink from giving doses large enough to control the pain. One of them has said that "morphia never killed anyone in pain." Most probably the pain is related to the nervous reflex from disturbance of organs and viscera. Allied with the pain is the fear that even the bravest experience. Frequently the neurosis set up, as traumatic shock is followed by rapidly accentuated weakness, is beyond the patient's control. It has been said that no one severely wounded in war is ever free of this neurosis in after life. At the initial stage it may present conditions of great difficulty in handling the patient.

Second, the response of the body to a burn on its surface is an outpouring of exudates of which water is the chief constituent. As the liquid leaves the interstices of the tissues, other liquid rushes into the space vacated. The only source of such replacement is the plasma fluid of the blood in the circulatory system. The resistance of the capillaries, which normally regulate the turn from the finial arteries into the return systems of veins and lymphatics, is overborne, and the plasma liquid is withdrawn from the necessary blood volume into the tissues, tending to outward movement toward the surface further to increase resistance to dehydration caused by the burn.

It was to check this effusion to the surface, with its disastrous consequences to the interior of the body, that the tannic acid treatment was introduced. The crust formed by the action of the acid on the exuded sera became a check upon the outpouring of liquid. The limitation upon the effectiveness of this method was that, if there should be agents of infection below the tannic crust, nothing could be done to control the infection until the crust had been removed. Every surgeon has had cases, as I have, in which removal of

the crust was the first step toward beneficial treatment of a burned area.

When the plasma fluid leaves the vessels in considerable volume, and passes into the interstitial spaces instead of the capillary venules, the blood volume of the veins decreases; when oxidized it does not fill the arterial system, the red cells concentrate for want of the liquid by which they are normally held in solution, the blood pressure fails, and the tissues of the whole body are left without the sustenance from the blood they need in the emergency.

Tannic acid checked the outpour. Plasma replaces the lost fluid. Tannic acid helped the body restore the water balance, but slowly, and from materials held by the tissues. Plasma adds to the blood volume within the walls of the circulatory system, where it is most needed, and with no delay.

Administration of water would tend to restore the balance, but in severe burn conditions it is not retained in the blood. Isotonic saline solution may last longer, but is soon excreted, and the hemoglobin concentration continues. What makes plasma infusion more effective is that it carries with it the liquid proteins that are requisite to the blood and that resist the processes of excretion by adhering to the vessel walls until they become incorporated in the blood fluid.

There is a third reflex from the burn trauma. The cortex and medulla of the adrenal gland are affected. There may be hemorrhage into the tissue spaces of the cortex, and even destruction of the cortical cells. Herein may lie the explanation, at least in part, of the failure of the capillaries. While it has been demonstrated that the capillaries have an independent control, associated with the pituitary gland, pituitary extract has proved ineffective in cases of burn. On the other hand, adrenal cortical extract has proved to be of definite advantage when administered in secondary shock conditions. Its rôle would seem to be that of countering the element of traumatic shock while the plasma fluid redresses the loss of blood volume and accessory proteins. The relief thus given operates also to renew the normal shift of fluids into the circulatory system, and so to further fit the body for the processes of recuperation involved in cleansing the wound and preventing infection or in combatting infection if it appears.

The fact that plasma has been supplied in quantities hitherto unthought of is to be attributed to the knowledge, and since 1939 the experience, that aid must be given to great numbers of subjects, and, even more important, given within forty-eight hours of the injury, sometimes within twenty-four hours, sometimes as late as seventy-two. To deal with such problems, the plasma liquid with its protein content, or the desiccated proteins in distilled water solution, must be available when needed. Infusion of whole blood, except in the case of severe hemorrhage, would not serve the purpose as well, since it would not lessen the hemoglobin concentration. In any event, the delay, incidental to matching blood types, may render infusion of the whole blood impracticable in this kind of warfare.

Except to remark that refinements of method with a view to producing plasma that will be sterile when its use is required, are being constantly improved, we need not here go into the methods of production, other than to note that they consist in the precipitation of the red cells, and some others, leaving a clear fluid in which the blood proteins are retained. In a supplementary process, and in deference to the knowledge that the liquid plasma is a rich culture medium, the essential components are made available in a dry state.

Laboratory estimation of hemoglobin concentration affords a good idea of the amount of infusion required. With a normal 100 per cent of hemoglobin there is a normal blood volume, of which the average would be about five liters. Of this, about three liters would be plasma fluid. Increase in hemoglobin concentration may be taken as showing a loss of blood volume, roughly proportionate in reverse. Thus a 10 per cent increase in concentration means a 10 per

cent loss of fluid, which only plasma will replace. An amount so calculated may be given, intravenously, while preparing for cleansing the burned area. A liter is the usual first infusion. After the cleansing, more may be given in keeping with the hemoglobin estimation. During the later infusions, which may run to three or four liters before stability is established, given at a drip speed of about ten a minute, there should be careful and repeated observation to avert overdosage.

Since we know that when the blood volume has been re-established and the permeability of the capillaries has been readjusted so that blood supply and returns function normally, the body will proceed to build up a granulating covering up to the skin level by means of exudates, and that in the best conditions this may take no more than three weeks, the cleansing of the skin and the prevention or control of infection are to be begun at the first possible moment.

An infection is something to be foreseen and, therefore, to be prevented; and as invasion by streptococcus is the one most to be apprehended, the burn area should be dusted with sulphanilamide or sulfathiozole, both of which are bacteriostatic as to these germs, even before the patient reaches the hospital.

Nearly always there is contamination, and while contamination is not infection the first cleansing procedure is addressed to its elimination. Morsels of clothing and of burned tissue are to be cleared away, with liberal douching of sodium hypochlorite (Milton) or magnesium sulfate.

When infection manifests itself, I hold that the best results, looking to its control, are to be had through close co-operation between the operator and the laboratory. Before infection can be fought successfully one must know what kind of invisible life is responsible for it, and on that point the laboratory will supply information that cannot otherwise be obtained.

If the laboratory tests show streptococcus, the origin can be ascribed to conditions within the wound area. To combat such infection is the really serious problem. Too often the laboratory findings point to infection having been introduced by some member of the team; or from cross infection within the hospital; or from infected air of the particular room. Where the reports show Bacillus faecalis, pyocyaneus or Staphylococcus viridens, there is no escape from the deduction that it has been brought to the wound from somewhere along the line of the team, whether operator, dresser, assistants, nurses, orderlies or others who have been in contact with the patient. Burned patients have no effective resistance to offer to such invasion. Where there are numbers of cases to be dealt with the danger increases. The most meticulous care must, therefore, be taken from the outset to guard against infection from hands, gloves and spray in breathing. Particularly in centers to which burned patients are distributed in war time, this concern for cleanliness, masks, etc., has come to be a rigid routine. Indeed the assurance that such concern can be counted upon is one of the reasons for establishing such centers.

Every effort should be made to eliminate these secondary infections in the early cleansing of the wound, and, later, to guard against a dressing or the waters of a bath becoming unsterile.

To illustrate the advantage there is in collaboration by operator and laboratory, it may be mentioned that the antiseptics, or rather the bactericide and bacteriostatic compounds whose exceptional value is now being demonstrated, are selective in their attack. Thus while one of the new compounds, called "propamadine" in shortening the technical word of forty letters, will dispose of a persistent streptococcal infection, such organisms as Bacillus proteus and Bacillus pyocyanea actually flourish in its presence, and that fact, if undetected, has been known to lead to failure of a thin epidermic graft, the skin graft whose "take" is more certain than any other.

The best cleansing material for a burn wound is the cetyl trimethyl ammonium

bromide, of Colebrook, in 1.5 solution, applied without anesthetic for three minutes. The wound is then washed in sterile saline to admit of taking a second swab for laboratory report. In this cleansing the effort is made to eliminate all contamination, especially morsels of burned skin, particles of clothing fabric, and any other foreign matter.

It is now accepted that the antiseptics which were in favor only a few years ago are of no practical service in the control of infection. The sulfa compounds, on the contrary, have demonstrated their value.

Sulfanilamide, as a preventive of infection, is applied lightly, as a powder, at the earliest opportunity. After the cleansing of the wound, it is again applied, this time in the form of a cream, from which there is a steady emanation upon the wound. This avoids the risk of caking, and of entering the system. If its systemic use is found desirable, it is utilized in the manner suited to that intention. The purpose of the cream dressing is to prevent the multiplication of bacteria on the burned area.

The cream is compounded of

	Per Cent
Sulphanilamide	10
C.T.A.B.	1
Castor Oil	25
Beeswax	1.8
Wool fat	1.8
Cetyl alcohol in water	5

This is applied on sheets of gauze, covered with wool, and bandaged. It is left from seven to twelve days and may be renewed for another four to six days.

If when the dressing is removed the burn shows exuberant granulation, is grayish, sensitive, with wet discharge and without peripheral epithelization, infection is not under control. The laboratory will show to what this is due. If it is due to lack of precautions somewhere in the staff, measures will be taken accordingly. The agents of infection most to be dreaded are Staphylococcus hemolyticus, Streptococcus hemolyticus, and, more potent than either, beta streptococcus hemolyticus. The compounds used against them begin with those that are bacteriostatic, followed, at need, by those that are bactericidal. This may mean a nice selection among the sulfonamides, as a beginning. If the result is not satisfactory, very remarkable results have been obtained by recourse to penicillin. This substance, derived from a fungus, and administered in a watery solution, is bacteriostatic, and brings remarkable aid to the body defences, which destroy the bacteria while the penicillin prevents their multiplication. A third recourse is to propamadine, strongly bactericidal.

For control of elements of infection other than streptococcus, if change of dressings reveals an unsatisfactory condition, recourse is had to sodium hypochlorite (Milton) in strength of 1 in 20 to 1 in 7.

When, after sloughing is complete, the burn area is a healthy red, it means infection has been controlled, and skin grafting follows.

There is, in the nature of things, considerable diversity in burns. They differ as to depth, location and extent. While they all come under the same series of treatments; shock, sedation, cleansing, control of infection, and eventual skin grafting, it is evident that a burn on the face calls for something that may not be demanded in a part habitually covered. A burn on the hand, with its complex attributes of function, presents other problems than would a burn of similar extent on the adjacent forearm. And a burn that deprives the body of from a tenth to a third of its skin covering makes heavier demands on the operator's knowledge and skill than does one of more modest proportions.

We may take first the burn that destroys large areas of skin, as on the neck and chest, the back or abdomen, the arms or legs, or some of these in combination.

There are limits to the pain anyone can endure, and the cleansing of the burn areas will go very much better and faster if the pain can be overcome. The best way to do it is to immerse the patient in a bath of sterile saline solution maintained at about blood temperature, and in a warm room.

By slings from the sides of the bath he can be assured a restful position, the water makes a good cushion, and the heat gets rid of most of the pain. The dressings drop off of their own accord, and after a half hour or more the burn area can be explored by the attendant, with gloves and under water, for the removal of every sort of detritus, dead skin, or whatever would harbor the bacteria of infection. This method has been developed on a war scale by McIndoe.

In these cases there may be no epithelialization at the edges of the wound, and burnt epithelium piles up on the granulating base, tending to infection and rendering sterilization difficult. Practically painless removal of these accumulations is a good start on the way to healing, and this becomes possible with immersion twice a day for periods that will not weaken the patient. He there has a freedom of movement not practicable elsewhere, and his comfort operates to avert disturbances of function, as of hands and feet, that might otherwise supervene.

The sulfanilamide treatment goes along with the immersion. Before it began he had had the wound area covered with one of the sulfa compounds, given in lanette and covered with tulle gras or vaseline gauze. This loosens off in the bath, and is renewed when he is transferred, naked, to a sterile sheet in a tented bed and kept warm by radiant heat lamps. The tulle gras or vaseline gauze is overlaid with saline packs. If the burns are front and back, the one on which he is to lie is dressed before he is transferred to the sheet and tented bed.

The immersion principle can, of course, be applied to small areas as well as large, with vessels to suit.

Also, at the conclusion of the treatments for cleansing and to control infection, large areas as well as small can be skin grafted, and should be. It may be that only pinch grafts can be employed, but these, as will be seen later, constitute effective replacement of the lost skin.

In the treatment by immersion the comfort of the patient is recognized as a factor of prime importance to the operator. It is even more than that, for it is well established now that everything which tends to restore the body's own capacity for resistance and repair is a definite aid to the healing process. Warmth, as we have seen, is one contributory influence. Rest is another. The value of rest to the tissues is what dictates the enclosing of wound areas in plaster casts when the patients are to be moved for considerable distances before they can receive full attention.

The same principle is applied, in some instances, to the treatment of some wounds and burns. While open treatment is in the main to be preferred, there may be an advantage in casing the arm in plaster or crilex when the burn is on the hand, or the hand and arm. After the first dressing, if the arm is thus enclosed there is security against cross-infections from outside, and also a stay of the lymphatic process by which any infection within the tissues of the arm might be carried into the system.

It is probable, moreover, that when there is a severe burn of the hand, and accompanying excitation of the tissues of the arm in which the tendons leading to the hand are imbedded, this excitation may account in part for the hypertension and static flexion typical of hand disfunction in these cases of burns. Rest given to these arm tissues, by the plaster cast, tends to avert this disturbing action while the hand is being prepared for reception of a graft. The hand itself is never so enclosed. Maintained in the "position of function" or the "position of grasp" it is prepared, like any other burn, for the reception of a graft. The basic position for rest of the hand begins with slight dorsiflexion at the wrist. Fingers are at mid-flexion at all joints. The thumb is in apposition with the tip of the index finger. The long axis of the fingers points toward the lower radius. The wrong way is to place the hand in full extension. It drops at the wrist, the fingers become hyperextended at the metacarpophalangeal joints, the long and short flexors of the fingers and joints become acutely flexed,

and we have the irretrievable disaster of the "claw hand." Air pilots cannot be exposed to that fate, and it is they who get the larger share of hand burns. For the dorsal area and the fingers, an intermediate epidermic graft gives a flexible covering with normal coloration. On the palm a covering of greater density is required. Even where there is known disturbance of the tendons, which must be left for later attention, the covering should be gone on with. If the necessity of a later operation is foreseen, which means that the covering must be opened, the palm cover might be with a pedicle flap rather than a free full thickness skin graft, since in the latter the subcutaneous tissue and part of the corium are removed before transfer to the defect. When an intermediate or full thickness skin graft is applied over an area that has been treated for burn, and when the defect apparently has been cleared of infection, it is a wise precaution to infiltrate the space between the wound and the graft with prontosil, for greater security.

Another variation from the open healing method is that in which recourse is to the Bunyan plan for frequent irrigation within a bag of specially woven silk. After surgical removal of burned tissues and liberal douching with sodium hypochlorite (Milton), an arm, for example, is enclosed in the bag, which has inlet and outlet openings, and irrigation with the hypochlorite solution is made three times a day for twenty minutes.

Infection material collects on the lining of the bag, which must be sterilized and renewed. It does protect the burned area from infection from outside. It is a convenient resource when local irrigation is desirable, but since it is not effective in demonstrating that the hypochlorite masters all bacteria its use, like that of tannic acid, tends to be relegated to the history of surgery.

Burns from phosphorus, all too numerous in the kind of warfare that includes the burning of cities by means of incendiary bombs dropped from airplanes, call for special treatment. The burn is immersed, if possible, in a weak solution of sodium bicarbonate. Obvious particles, of all kinds, are removed by forceps. No oil or grease is to be applied. Next the burn is washed with a 1 per cent copper sulfate solution. In the chemical reaction copper phosphide is deposited. This is removed and the wound dressed. As there may be hidden particles of phosphorus, dry dressings are to be avoided.

With any or all of these methods, we come to a time when, so far as the burn area is concerned, grafting may follow. The weakness of the patient, however, may still be such as to make replacement by autografts of the necessary size impracticable. In some such instances, homografts are applied, in the expectation that they will last until the patient is strong enough to admit of autografts being taken. Where there is weakness, or where the state of the burned area is not satisfactory, some form of grafting should nevertheless proceed, preferably with pinch grafts, or with small isolated patches of epidermic graft. There is a spread of epithelialization while the healing continues. I have already mentioned that, where replacement can be made, injection of prontosil below the graft gives additional assurance of its success. It should be mentioned, also, that grafts on exposed parts, as on the face and hands, should not be exposed to direct sunlight, which will cause burns whose presence will not be signalled by the graft, since for a long time it is without sensitivity.

As I commented at the outset, this whole process leads up to a stage at which the special knowledge of grafts becomes of critical importance. Now that the whole picture has changed, and grafting is to come within a few weeks of the injury, the profession will adapt itself to the condition, and we will have fewer cases that present themselves months, or even years, after primary treatment has left the patient with masses of scar that contracts as it solidifies and that is destructive of function besides being disfiguring. In war conditions

cases are sent to centers where the proper treatment, with the necessary safeguards, has been organized. We shall find, later on, that the same principle will be applied within hospital organization. The régime under which every doctor attended his own burned patients is on the way out.

What form of graft or other replacement will be selected when the burn area is ready to receive cover will depend on the judgment of the operator and the condition of the patient. We need not here go into the considerations that influence selection as between epidermic, intermediate and full thickness grafts, or that favor pedicle flaps as against any of these. Nothing of that has been changed by war conditions.

An exception might be made in respect to the tiny pinch grafts, however, since they provide a means of dealing with extensive burns when the state of the patient prevents recourse to forms of grafting that would be preferable.

The pinch graft will not do for the face or hands, because of its lumpy appearance, but it does produce a satisfactory covering for even a very large defect on the arm, leg or other area not exposed, admitting freedom of functional motion under it when the epithelialization it promotes is complete.

Where adequate material to cover such a defect is not to be had, or the patient is too weak to allow of its being taken, tiny grafts, 2 to 6 mm. in diameter, are spaced at distances of rather less than 1 cm. About sixty of them will suffice for a defect area of the whole length of the arm.

The grafts should not be lifted from an area that can be drawn upon for large grafts. An area two to six inches square will supply them in unexpected quantity if taken only ¼ to ½ cm. or so apart. The hip offers a convenient patch. It is prudent to mark them before lifting, in blue, so that when transferred there is assurance of their being right side up.

So marked, a straight needle is engaged in the epithelial layer, the graft is raised in a small cone, and with a sharp scalpel the cone base is cut through at the skin level. It is removed at once, by the needle, to the granulation surface, which has been prepared with saline but not scraped or shaved. Two or more can co-operate in the work of lifting and applying the grafts.

These grafts, small as they are, include all the essential elements of the skin, the outer epidermis, the germinative epithelial stratum, and something of the papillae and other constituents of the corium. Placed carefully against the granulations, with the epithelial edges spread flatly on the surface, they become islands of epithelium from which proliferation proceeds in all directions, in time providing a skin covering for the burn area to which they are applied.

A hair dryer is used from time to time to dry the surface and coagulate the serum exuding from the granulations. The area on which the grafts are imposed is covered with tulle gras, and then by gauze wrung out in paraffin and flavine.

Dressings are removed for inspection in from three days to a week. If there are evidences of continuing mild infection in the defect, saline dressings are kept on. Otherwise tulle gras dressings are again applied.

To sum up, the experience gained in treatment of burns under stress of war conditions come down to this. Plasma and the sulfa compounds have completely displaced the tannic acid-silver treatment of burns, and the long delay incidental to that treatment has been replaced by skin grafting of all burn wounds within five or six weeks of the injury.

TISSUE GRAFTING*

J. EASTMAN SHEEHAN, M.D.
Professor of Plastic Reparative Surgery, New York Polyclinic Medical School and Hospital
NEW YORK, NEW YORK

IN a very large part, plastic reparative surgery has to do with the replacement of tissues that have been lost. The losses are of various origins. They may be due to congenital maldevelopment, to disease or to trauma. They may be produced surgically, as part of some procedure in correction; or by excision in the treatment of disfiguring lupus, approachable cancer or disfiguring birthmarks; or by removal of contractile scar that tends to inhibit function and produce disfigurement. Even in taking a graft for replacement there is a loss which must be replaced.

The loss may be in any of the elements that go to make up the structure of the body, in bone, cartilage, fascia, tendons, nerves, vessels, membranes and skin. When, and at whatever stage, the loss becomes the subject of surgical concern, replacement is called for in the interests of health, function, esthetic betterment or of all three.

The body is itself the source from which the materials for replacement are drawn. The tissues so disposable are living entities, not inanimate compounds of fabrics. Their employment, to be effective, imperatively demands a precise knowledge of their composition, their characteristics and their behavior under stress of the new burden imposed upon them. Lack of such knowledge, or of the respect which is the tissue's due and which it inevitably commands, is reflected, later, in imperfection in the end result, or in failure. Thus bone, under certain conditions, will disintegrate or be absorbed, whereas in others it will live. Cartilage will support certain other tissues if its strength is accurately estimated, but not beyond its strength. Skin will do practically any thing that is demanded of it, but only if the conditions under which it will so respond are known, and if they have scrupulous attention at all stages of the replacement. Nerve and tendon replacements are similarly exacting.

Skin Losses and Replacements. If we are to develop these considerations, it will be convenient to begin with the tissue that is most frequently drawn upon in replacements, the skin. Always to be borne in mind is the fact that the skin is a flexible envelope covering every part of the body. It encloses all the soft tissues, without constricting them, and without influence upon their function. Both by its situation and its extent it is more exposed to trauma, and so to loss, than any other tissue. It carries, within its multiple strata, an active agent for the repair of its own losses, and for the covering of small areas that are denuded of its protection. When taken from one part of the body and transferred to another it will still live and will replace the lost covering of other tissues, thus assuring restoration of such functions as may have been inhibited through the loss of the flexible covering and the substitution of a covering that is constrictive.

Evidently, if there is to be reliance upon the usefulness of such a tissue in replacement procedures, the first consideration is certitude that the tissue so removed will live in the area to which it is transferred, and will have the non-constricting attributes of a true and natural covering of the tissues beneath it.

Upon what can that assurance be based? The answer to this question is to be sought in knowledge of those elements of the skin tissue which bear upon its capacity for continuing its own existence and, therefore, for remaining viable and fulfilling its function when removed to an area where the

* Lectures given at Oxford University October 28, 1942 and November 4, 1942.

problem is one of continuing or of restored activity as a living tissue.

There are two parts to the skin: To one of these a blood supply is necessary; to the other part there is no sustenance from vessels. It happens that the part presenting the lesser difficulty is toward the surface. A thin shaving of skin from the outer, epithelial layer will thrive upon the fluids present in the base upon which it is set. Where the underhalf of the skin is included, the requirements are entirely different and more complex. In the original locus, it has a full complement of arteries, veins, capillaries, lymphatics, nerve branchings and nerve endings, besides sweat and fat glands and hair follicles. Severance of the skin, by depriving these agencies of their normal association inherent in the continuity of the skin, tends to render them moribund, and unless there is restorative process by which the skin resumes infiltration by vessels, as arteries, veins, lymphatics, the skin dies. If it does, the attempted replacement goes for nothing and the repair fails.

Assurance that a graft or other skin replacement will live, therefore, varies with what is necessary to make it live. These necessities, being essentially different in the outer or epithelial strata and in the inner or corium layers, are basic to every selection of the type of replacement appropriate to the particular problem of repair.

That there will be such selection follows from what is common knowledge of the variety and the extent of the losses to which the skin covering is exposed. It may be so little as involves only a portion of an eyelid, the result of accident or of surgical intervention for the correction of a local anomaly. It may, on the other hand, as the consequences of a devastating burn, include most of the surface of the arm, leg, torso or abdomen. Between these extremes there is every degree of loss, in kind, quality and size, arising from congenital maldevelopment, trauma and disease. There is, again, the matter of disfigurement, having to do mostly with areas habitually exposed to view. To maintain consistency in skin levels, in coloration, is as important in these cases as to provide covering. This is not true to the same extent in parts habitually covered. The point here is, no one type of skin replacement would serve in every instance; and since there must be selection the choice evidently must be governed by consideration for the area of repair and in part with reference to the shades of difference between the skin shaving of epithelium and the substantial body of full thickness skin.

This brings under review, for purposes of distinguishing between their uses, the principal varieties of skin replacement from which selection will be made. There is the epidermic graft which may be translucently thin; an epidermic graft with a trifle more substance, a graft which incorporated the outer, epithelial layers, the inner generative layer of epithelial cells, and the tops of the papillae within the corium, which this generative layer invests. Then there is the graft which includes all this last and strikes a little lower into the corium, called, descriptively, an intermediate graft. Last comes the use of full thickness skin which may be in the form of a free graft fully detached from its surroundings or of a flap which continues to be nourished by its own vessels, which are supplied through a pedicle that retains its normal circulation and continues it into the part constituting the replacement. The tiny pinch graft, in some situations the only available recourse, carries all of the epithelial elements and the corium, in varying proportions. Its value lies in the proliferation from the germinative layer which covers the interstices between the main layers of skin.

Importance of the Time Element. While selection of one or more of these types of skin cover must be made in any and all conditions in which repair is to be undertaken, it is important that replacement be effected as soon as practicable after the loss has been sustained. If that is done, the tissues that are covered continue in normal function. Where, on the other hand, as so

often happens with burns, mistaken concern for the welfare of the patient leads to leaving in place skin whose structure has been materially affected by the injury, the connective fibers that make up the corium lose their flexible and elastic qualities and the skin becomes contractile as the tissue develops into scar. In these conditions, free functioning of the tissues under the skin cover is progressively restricted and disfigurement and distortion are inevitable. Notably this is true in areas where function depends on the action of joints and tendons. Where the loss is of sound skin, displaced by wound or abrasion, but available for replacement, it can be returned over an open wound during a short period after the injury. Opinions vary as to the lapse of time within which this will be successful. I find four hours fairly safe.

Epidermic Graft. The selection of a replacement naturally begins with consideration of what is to be achieved and what should be avoided. For example, if we have to deal with a cul-de-sac to be furnished with a simulated eyeball, the first problem is the lining of the cavity after a surface has been prepared. This surface will include the walls of the cavity and probably also the inner aspect of the upper and lower eyelids. The lining of the upper eyelid must be very thin, as otherwise its motion would be impeded. The lining of the cavity must have the utmost certainty of "take," because of the situation and configuration. There must be a pouch within which the prosthesis will be comfortably and steadily held; and there must not be, as sequel to the replacement, growth of hair or rancid emanations.

Only the thin epidermic graft meets all these requirements, since it consists of a mere shaving from the epithelial layers of the skin, is in no way dependent on vessels within it, is readily nourished by the fluids present in the base upon which it is imposed, and can easily be given the form desired by the simple expedient of wrapping it around a mould of stent, outer surface next to the mould. To these positive advantages is added the important negative one that, since the sweat glands, hair follicles and sebaceous glands all lie deeper within the skin, none are transferred to the new location where such emanations would be annoying.

The controlling factor in all this, the one by which the epidermic graft is distinguished from all other skin replacements, is the ability of the epithelial cells to derive from the all pervasive lymph fluid the sustenance they need for continued life.

To be carefully noted, however, is the fact that so very thin a graft has a tendency to shrink. It must, therefore, be maintained in place by immobilization over what may seem a long period after the "take" is assured, until there is complete organization between the graft tissues and those of the base.

Also, there is the problem of coloration. In the undivided skin there are some wandering dark cells in the epithelial layer. These escape downward. In the epidermic graft, either they escape outward, or, if they remain, give a melanotic tinge to the graft. This may result in a prune juice color which will constitute a disfigurement if there is a patch of it in an area of clear skin in an exposed place. Use of the epidermic graft on the face is, therefore, contraindicated, except in the case in which a general darkening of the skin having been produced, as by some orders of burns, it might conform to the rest. Again, being as thin as it is, a patch of this graft would fall below the general surface level of the denser skin. Such a depression would be a disfigurement.

Not all replacements are on the face, however, and the further and often determinative advantage of this graft is that it can be taken in effectively unlimited amounts, and, if necessary, from more than one area. The repair is not prejudiced if the edges overlap in the procedure of replacement. Moreover, when this graft is lifted, the epithelial surface from which it was taken immediately begins the accomplishment of its own repair.

Intermediate Free Skin Graft. While the thin epidermic graft will provide a cover for a very small or a very large defect, it leaves something to be desired where either coloration or density of substance demands consideration.

The lowest layer of the epidermis consists of the germinative epithelial cells. These cells work their way to the surface, becoming less and less potent as they go. Most of the seven or eight stratifications are flat, and lie horizontal to the surface. The germinative layer is an exception. A basal membrane separates it from the corium, but the papillae, the monticules of fine connective tissue in which the vessels of the corium end, push their way into this stratum and render its floor irregular. A graft taken deeply enough to include part of the germinative layer must, therefore, include the tips of these papillae, and to that extent, would not be an entirely epidermic graft. It would, on the other hand, have within it all the overlying strata and something of the lowest lying and in many ways the most important.

Experience has demonstrated that this graft, intermediate in thickness between the epidermic and the free full thickness grafts, is equipped to derive from the lymph of the sera of the defect the nutriment essential to the continued life of the cells. So far is this true that the intermediate graft does not, ordinarily, require the aid of sutures in effecting coaptation with the skin edges of the defect on which it is applied. So natural is the union that often there is so little trace of eventual scar that it is difficult to define the area of replacement. It may be difficult even to identify the replacement, and that fact illustrates the second advantage of this graft, which is that when the whole depth of the epidermis is taken the surface coloration is retained in the new situation. Since it is known that skin coloration is influenced by the patency of the capillaries, it may well be that the inclusion of the tops of the papillae conduces to the desired result of rendering the graft indistinguishable from its surroundings.

By the employment of a calibrated instrument known as the dermatome the thickness of these grafts can be more or less accurately adjusted, the effusion from the vessels of the papillae need be little more than pinpoints, and recuperation of the donor area presents no serious problems.

With so serviceable a material at hand, it is obvious that recourse to it will be frequent. One might, for example, find in the shaving of epidermis an adequate cover for a forearm denuded of its skin, over a considerable part of its surface. But the covering of that part of the arm would be visibly different from the rest, both in consistency and, as time went on, in coloration, the replacement becoming progressively darker. With the intermediate graft, on the contrary, it might be difficult to recognize any difference whatever.

Again, in replacement on an exposed area, such as the back of the hand, rather more body to the cover is demanded than the thin epidermic graft would supply, apart altogether from esthetic considerations. The retention of color and the facility of "take" combined with the density suited to the functional need, exemplify the utility of this type of graft in one situation and indicate its superior usefulness in many.

Free Full Thickness Skin Grafts. This denser and better appearing graft does not, however, meet the requirement in all cases. For example, if it is the palm of the hand that needs a new cover, weight must be given to the obvious fact that the skin of the palm is denser than almost anywhere else on the body, and that the best repair would be in kind. Similarly if a lupus condition calls for removal of a section of the skin of the face, the material of replacement chosen must be such as will harmonize with the adjacent facial area in color, thickness, texture and in everything least likely to attract attention after the repair is complete.

Only skin of full thickness will meet this test. When that decision has been reached, there may still be a choice of methods. The replacement may be brought by means of a pedicle flap, or it may come as a free full thickness graft brought direct to the defect from a distant part of the body.

The difficulty about utilizing a flap from an adjacent area is that it tends to produce one disfigurement in getting rid of another.

The alternative method has so many features making it preferable that no effort is too great if its application will increase the certainty of success.

There is no better index of the progress in this sort of surgery than the improvement that has been made from the time when a doubtful 50 per cent success attended transfer of full thickness free skin, to that in which, barring some unpredictable and intractable variation in skin or body chemistry, success is practically uniform.

In keeping with what has been said and respecting the tissue of which we demand this high service, it will be convenient to mention here some precautions it is important to observe.

One considers first the patient. If his skin is not in a healthy state, if there are pimples, boils, etc., suggesting complications even at a distant stage, if an abnormal platelet count warns of possible oozing, intractable bleeding, blood clots, etc., there should be postponement until these conditions have been cleared up.

Next one considers the state of the defect. If granulations are painful, if they are grayish, if there is exudation of pus, if there is no epithelial response at the wound edges, there should be no grafting until all this has been righted.

Then as to the graft itself. One should seek to be satisfied that the oxygen and sulfur content of the skin in the donor area is normal. For better assurance as to this, the area to be incised is cleansed the night before the operation with soap and water, then with sulfuric ether, with light soap and water wash in the theatre. No antiseptics are to be applied to the skin preliminary to incision. Incision is to be with a sharp knife and made with no bevelling of edges or jagged lines of incision and no heavy handling of the graft or squeezing with forceps. The under tissues and lower part of the corium should be sheared off.

At the defect, the graft should be imposed only on a dry base, always with size A silk, as a precaution against infection. Approximation should be even and thorough, with no slack in the graft, but rather slight tension. The graft is immobilized by bandage, with pressure of a kind and degree suited to the actual case.

These precautions are indicated, primarily, by the knowledge that infection is the one enemy to be feared in this order of replacement, and secondly that the skin we are here dealing with is in two wholly dissimilar parts. The epidermis is not now detached and left to assimilate its nutriment from the lymph that is directly in contact with it. The epidermis now rests upon the corium which is its natural complement and is dependent upon that body. The corium, on its part, is not vitalized by the lymph. Cut off from their accustomed communications, the vessels that permeate the corium must have that communication restored, with the help of branching of vessels in the base.

We have seen that the epidermic and intermediate grafts do not need too careful an adjustment to the wound edges. They effect their own epithelial approximation. It is otherwise with the fibers of connective tissue that compose the corium. Apposition of graft edges of this composition to the similar edges of the defect depends on exactness of pattern and upon the most delicate suturing, if scar and unevenness are to be averted in the final state.

An accurate pattern of the defect is best secured from lint saturated in the blood of the defect. Accurate reproduction of the pattern requires a knife that has none of the imperfections which produce jagged edges. A fractured razor blade produces a useful instrument. Accurate suturing is not possible if the edges of the graft or of the

defect are bevelled or uneven. Hence the incision must be vertically straight.

The graft is not to be bathed in saline or other cleansing solution. It is left in the sera of exudation caused by its excision and benefits by two qualities of such sera, one, resistance to infection, which is the ever present enemy, the other rendering the graft adherent to the defect base during the first twenty-four hours, the time needed for the restorative process to set in. The restoration process is facilitated by eliminating the coarser connective tissues at the bottom of the graft.

The skin, in its now weakened condition, is transferred to the defect by means of threads diagonally spaced. These will serve as anchor sutures in the new situation. From these bases the suturing proceeds, with the utmost discrimination, until the defect is regularly and smoothly covered. The donor area is covered by epidermic skin graft.

Every precaution having been taken, in relation both to the graft and the base upon which it is imposed, attention is henceforth concentrated on facilitating its revival. This depends on return of vascular circulation within the corium section. One reason for having the graft slightly on tension, rather than loosely covering the defect, is to ensure that the contact with the base is complete and uniform. This contact, at first established by the sera, is maintained by pressure. That pressure must be nicely guaged. With too little pressure, the two bodies tend to separate and the essential communication between their vessels is lost. With too much, the branchings which begin from the arteries in the base do not penetrate. In either case, the vascular supply requisite to restoration of the corium does not reach the graft and it fails. This is illustrated when, because of incomplete contact with the base, the graft dies in those spots where contact and even pressure are not maintained. That the pressure to be applied closely approximates the normal blood pressure in the arterial flow has been confirmed in practice, but there is nothing absolute about the amount and there is some room for variation.

Whatever form of pressure bandage is applied, it may be removed for inspection from the second to the tenth day. A rose color in the graft is indication that life is returning to the moribund cells of the corium. Close observation suggests that this begins in the graft truncated as described, sooner than used to be looked for before that refinement was adopted. White patches bespeak failure, and if they persist, should be removed and subsequently replaced. After cleansing, dressings are replaced, and examination is continued by further removal and replacement until recovery is complete. Inflated rubber bags may be utilized to maintain consistent pressure. In some instances restoration will be promoted if the graft is held in position by a mold, and this in turn by adhesive tape.

In this postoperative period, solicitous concern is to be shown for any suggestion of a developing infection. Should such appear, the fact that everything possible has been done to avert it and has somehow proved ineffective in doing so makes instant attention imperative. Infection is the one serious threat to the success of this kind of skin replacement. Elimination of this danger, in successively greater degree, has made possible the use of the free full thickness skin graft in a greater variety of situations and in ever expanding amounts.

In the process of restoration, the vessels precede the nerves. Sensory return, being the latest, indicates completion of the repair.

Before that stage is reached, surface coloration asserts itself. While the graft has been taken from a covered area and has not the same coloration as the skin of parts exposed to sun, light and currents of air, the capillaries which govern in this matter and which are provided with a mechanism of their own, will respond, in time, to the stimulation of exposure, and will accommodate the coloration to the esthetic requirement of the adjacent area that has

been so stimulated habitually. In exceptional instances, as when the cover for a skin loss on the nose is taken from like material back of the ear, there is no delay for this adjustment. Ordinarily, the sites selected for the donor area are the abdomen, the non-hairy parts on the inner side of the left thigh, the outer side of the right thigh, or the inner side of either arm. There must be full muscular relaxation. Otherwise, as when there is bellying of the adductor longus on the thigh, or in the groove between the deltoid and triceps on the inner side of the arm, there is an uneven surface and the graft cannot be evenly cut.

Precision in Raising Grafts. There is today no reason why the general surgeon should not undertake these grafting processes, since he has at his command instruments to supplement the use of the knife. There is the Blair graft knife, with sucker or board; the Humby roller knife and board; and the Padgett dermatome, an entirely mechanical machine to supplement the preference for a sharp knife and board. In this latter method the graft is raised by the to-and-fro motion of the knife, of the surgeon's selection, laid flat on the skin surface.

Pinch Grafts. While very often the problem is to procure a large enough graft, a determination which may decide the selection of an intermediate rather than a full thickness graft, there are situations in which the recourse must be to numbers of the very smallest graft.

An example is that of an arm or leg on which there has been extensive skin loss, as from a burn, and when, because of the patient's condition or for lack of donor area of suitable dimensions, the pinch graft can be utilized to give a stable cover.

Tiny as it is, being only from 2 to 6 mm. in diameter, this graft incorporates the outer layers of the epidermis, the inner or germinative layer, and a section of the corium. Placed about a centimeter apart on a granulating surface, the grafts "take" in as little as forty-eight hours and dressings are removed within a week. From the edges an epithelial proliferation spreads out in all directions, gradually supplying the intervening spaces with a rough but stable surface covering. On the face, or other exposed area, such covering would be unsightly and the graft is not suited to be employed there.

When it is used at all it is employed in considerable numbers. These should not be taken haphazardly from an area that would provide other forms of graft and which would be spoiled for that purpose by the excisions. A small hidden area, as on the thigh or the iliac crest, will spare an abundant supply when judiciously spaced.

It is well to mark in blue the spots of surface it is intended to raise, so that they can be later identified as right side up.

The graft is lifted to a cone by means of a needle, and detached with a sharp scalpel, at the base of the cone and at skin level. These little islands have a periphery of epithelium. Each is removed to the granulating surface of the defect by the needle and is carefully spread. They are placed at distances of rather less than a centimeter and are kept in place by lint immersed in oil and balsam, with covering of cotton wool wrung out in flavine, 1 to 100 solution, and Dunlop rubber pads a half centimeter in thickness, the whole immobilized with adhesive. Redressing after inspection is lighter. If there is infection present when the dressing is removed, the parts are washed with salt solution or 5 per cent magnesium sulfate.

Pedicle Flaps. In all skin replacements the end factor is the same. The imposed tissue becomes incorporated with the tissue of the base. The agent of this organization is the blood supply. In the case of free grafts, the supply is by vascular infiltration from below. The process of restoration is, for this reason, least doubtful with the thinnest grafts and increasingly doubtful as the grafts are thicker. The very thin epidermic graft makes no demand, and will thrive on the nourishment afforded by the lymph in the tissue spaces. The intermediate graft requires vascular support, but its demand

is not heavy upon the blood available at the capillaries in the tissues of the base. When we come to the next stage, the so-called "full thickness" graft, it is no longer safe to count upon the supply from the base being adequate to the purpose. If the subcutaneous fat is left on the graft, the incorporation does not take place. The capillary blood supply is not capable of infiltration through the fat and into the corium. From the recognition of this it was a short step to facilitate reorganization by excising part of the lowest stratum of the fibers of the corium, so that "full" thickness became a misnomer. It follows that when there is evident need for a replacement that includes the subcutaneous fat, none of these forms of graft will serve. And there are conditions, such as the provision of a cushion over nerves, tendons and vessels, in which a cover denser than any of the grafts is essential to satisfactory repair.

The obvious reasoning then is that replacement skin that has its own blood supply has a better chance of survival. This is the condition that determines the selection of a pedicle flap. The blood supply from the pedicle helps sustain the life of the flap while new supplies are finding their way in from the base and from the edges. At the last, the pedicle is cut and the auxiliary blood supply withdrawn.

It follows from this recognition of the importance of an intrinsic blood supply that certain precautions are necessary. Care must be taken so to locate the pedicle that it encloses one or more vessels. The outline of the flap will not be by incision lines that cut across the prolongation of the vessels in the pedicle. If the flap is brought to place at once, it may be found that the inflow is too strong, and that, since the mechanism of return does not exist at the borders of the flap, there will be choking at the suture lines, followed by swelling, with danger to the life of the flap. The rate of inflow can be reduced by judicious application of pressure at the pedicle.

Delayed Flap. When a skin flap is brought to place and sutured as soon as it is lifted, the deposit of fibrins incidental to defensive exudation tends to interpose a barrier against apposition of the skin edges and so leaves a line of scar. The tendency with scar is to become contractile. Of itself, and by its effects it contravenes the rule of plastic surgery against producing one disfigurement while correcting another. It is decidedly desirable, therefore, to bring the flap to the area of repair in such condition that all mishaps may be avoided, if that can be done

By returning the flap to the bed from which it has been raised, much of this is accomplished. Resentment to insult is manifested, but at the expense of the graft tissues only. Its edges, when the time comes to lift it again, can be made such as will favor healing with the minimum of scar at the line of suture. What has gone on within the flap during the delay has made it more dependable. If left too long, there is a tendency to induration; but if the second lifting is within the week, this problem does not arise.

It may be preferable, in given conditions, to have the flap supported by pedicles at both ends. Or it might be found expedient to cover a defect on the hand by means of a pocket of skin of the abdomen, conserving the blood supply from two or more directions. In these, as in the simpler forms, the reliability of the flap is improved by the "delay."

Tubed Pedicle Flap. Whether it is brought to the defect immediately or after "delay," the pedicle flap is limited in location to the adjacency of the defect, and in extent to proportions inadequate to many replacements that must be made.

The amount required, by almost any demand, can be obtained, and at a distance from the defect to be covered, by recourse to a flap of two pedicles, lifted on the abdomen or other extensive skin area. The opposite edges are turned under, apposed and sutured, thus forming a tube. A continuing blood supply, from two directions, is thus assured. The denuded area is covered by skin graft, leaving the tubed skin

free to be used or discarded when transferred to a distance from its original site.

Although such a flap may be brought from the abdomen to the face or neck, the principle of a supporting blood supply is maintained; the migration, which is effected by raising the distal pedicle to a position nearer to the defect than the proximal pedicle, provides for blood supply from two pedicles until the very last stage, when there is still blood supply from one pedicle. It may be desirable to have the last migration effected by attachment of the pedicle to the arm or thumb, thus providing greater freedom of movement when the last distal pedicle is detached at the time of repair.

With such preparation, the flap is in the best practical condition, is ready for immediate application, has left behind it those complications that in a newly raised flap would tend to inhibit reorganization, either at the borders or with the tissues below.

Replacement material of this consistency, and which can be taken in amounts to meet any requirement, is adapted not merely to use in a great variety of conditions but can be relied upon to justify the creation of surgical defects that would not be warranted if the means of cover were not assured. Over deep defects, where more than one thickness of cover is necessary, it can be adapted to the situation with a minimum of attendant inconvenience.

Advancement and Transposition. The elastic property of the skin conduces to the covering of certain defects without recourse to pedicles. The adjacent skin is undermined to a depth consistent with the stretching that is to follow, and then advanced to apposition with the skin border beyond the defect. In some instances advancement may be accompanied by a rotation. This is notably true where there are multiple abrasions of the skin surface, rather than areas of considerable loss, which could be covered by a single replacement. These abrasion losses are apt to be of irregular contour and some excision may be necessary to produce suitable suture edges. The initial skin advancements, or some of them, may prove inadequate, but the stretched skin acquires, in time, the increase of elasticity that warrants its being advanced or rotated after fresh undermining. Since multiple abrasions offer the prospect of multiple scars, the ultimate of surgical precaution against more than the minimum visible scar appearing in the end result must be observed at all stages. The evident advantage is that the covering of defects is by the skin natural to the area, which does regain its normal texture after these disturbances.

The same elastic property of the skin can be brought into convenient requisition when some change in existing alignment is desired, notably in the oral and orbital regions. Skin on stretch, exerting a pull upon other skin to which it is attached, gives results that would not be produced by mere overlay replacement. By shifting the direction of pairs of triangular small flaps, a line is raised here and lowered there, or shortened in one part and lengthened in the other, achieving the correction desired. This manipulation of flaps outlined by incisions resembling the letter z is practicable in great variety.

The same principle is applied in eliminating areas of scar. Long scars resulting from burns, as on the neck, in some cases can be got rid of by simple excision, the defect being covered from the wound edges by skin advancement. Mere eradication of the scar and direct apposition do not suffice. Better suture lines and a more desirable ultimate form are assured by the creation of triangular defects beyond the scar areas, into which are fitted triangular flaps of skin advanced from the opposite sides. In the patterning of such flaps, and of the receiving angles, there must be scrupulous regard for the symmetrical requirement, as otherwise the approximation will be irregular and the end scar undesirable. With the opposing angulations patterned in strict conformity one to the other, the best result is assured.

Depressions. The atrophy of facial muscles and other conditions that may be met with result in disfiguring depressions. To effect a continuous surface level, small amounts of skin may be introduced in a single layer or in rolls according to need. As the presence of a hard tissue immediately below the surface would be readily detected, the epidermic surface is removed, and, to the same purpose, the inner, softer part of what remains is kept uppermost, next the undersurface of the cover skin. Error in this adjustment will become evident to sight and touch.

Variants of these rolls of skin may be found useful in filling a small depression on the nasal dorsum, or in lending firmness to a columella or otherwise improving its position.

Mucous Membrane in Replacement. Like the exterior skin cover, the mucous membrane of the cavities is a serviceable material of plastic repair. Either as a free graft or with one of its borders undisturbed it is dependable. Its use on exposed areas is limited by its color. It is the only suitable replacement for loss on the vermilion border of the lips. These, being extensions of the membrane of the mouth, cannot be satisfactorily replaced except by that membrane. On the other hand it is too red to replace loss in a visible area of the ocular conjunctiva. For this a membrane of scarcely perceptible tinge may be had from the middle turbinate.

Where there is a channel to be constructed to replace one injured or absent for other reason, the membrane has peculiar value. Unlike the epidermic graft, it is organically complete. It reorganizes with other tissues, therefore, on a sounder basis. It has practically equal assurance of "take." In corrective procedures for hypospadias, for restoration of occluded lacrimal drainage, and the like, it is the material of choice.

Other Materials of Plastic Repair. While the skin is the tissue most drawn upon, and of most various application in reparative surgery, all the other tissues may be brought into service at need. Cartilage and bone have the lead in this service, but fat, fascia, nerves, vessels, tendons, muscle strands, even the nails, respond when drawn upon.

Cartilage, which meets the demand for a material firm enough to support other tissues in fixed relations, is available in any quantity required. It is present in the nose in small but often sufficient amount which may be supplemented from the ear. The costal crest can be drawn upon for larger amounts and of a density adapted to heavier burdens. Being pliable, it is susceptible of adjustment to new forms. It can be shaped to fit a new situation. It is welcomed as a living tissue when newly inserted among other tissues, and so does not promote inflammations antecedent to expulsion. Continuing as a living entity, it does not deteriorate. Excess remaining after a repair procedure lives when implanted under the skin of the chest. Recently, such remainders have been found to retain their quality when kept for long periods in solution. There is a tendency to bend, but this is usually due, when it is observed, to faulty estimation of the quantity suited to bear the strain imposed. As the cartilage and its perichondrium react unequally to the new surroundings, the shape of the transplant will alter if the perichondrium is left in place. It therefore is removed except where needed for support, as over a sharp angle, or for suturing, as to the periosteum of the nasal spine.

In nasal readjustments, in which the cartilaginous septum and the alar cartilages are important elements of repair, the local supply frequently suffices for improvement of form and for filling incidental small bridge depressions. If there is need to replace the cartilaginous septum fully, it becomes a question whether to invade the costal crest, involving serious surgery, or to turn to bone for the necessary support.

Bone as Plastic Material. The guiding principle in relation to bone implant is that it should be, to the utmost extent practicable, in contact with bone. In the case of

an overlay of other bone, in which union after fracture is imperfect, the contact is ample. A bone graft mortised to bone to effect mandibular repair similarly fulfills the requirement. But where, as in supplying a substitute for the nasal septum, bone is employed, contact of bone with bone at both ends and on the floor of the nose is essential if the process of absorption and consequent disintegration is to be averted.

Bone from the iliac crest offers an acceptable alternative to the cartilage of the costal crest. Bone from the same area is peculiarly adapted by its curved conformation and the ease with which it can be given shape to replacement of losses on the skull. The iliac crest is approached by a curved incision, the periosteum reflected over the requisite area, and a thin plate of bone removed. The rest of the problem is concern for the promotion of osteogenesis in the new situation.

Tendons, Fascia, Nerves, etc. Loss of function in hands or feet, whatever other aspects may be present, is associated with constriction, displacement, or inadequacy, including loss, of the tendons. After they are exposed and freed, readjustment may involve lengthening, splicing of parts, or grafting, for which other tendons are drawn upon for the materials of replacement.

Fascia, the sheath of the muscle it invests in nature, is of great tensile strength in the direction of its length. It is invaluable in the mechanical correction of the mouth distortion characteristic of unilateral facial paralysis, and as suture material in the repair of hernia. Packed or in rolls, it is usefully inserted beneath the skin to eliminate depressions, alternative to rolls of skin. Fat is also available for this purpose, but whether it remains or is absorbed depends on body conditions in the individual which defy estimation.

In rare instances, an area of skin and its attachments may be transported for replacement at a short distance, attached to a blood vessel, the whole being carried through a channel fashioned under the intervening skin. Esser calls them island artery grafts.

Interrupted innervation, whose causation often is traumatic, may be restored by the introduction of nerve substance in the form of grafts. A considerable literature has been devoted to the use of this expedient in respect of the facial nerve.

An alternative to that procedure brings in the muscles as plastic material. The fibers of the temporal muscle, being so constituted as to have the same direction as their vessels and nerves, are turned on pedicles to overlie the muscles of the orbit, cheek and mouth, from which innervation by the facial nerve has been lost. The effect of the overlay is to reanimate these muscles.

Readjustment of muscle fibers is practicable for the correction or improvement of other conditions. Always it is a pedicle device, never a free transfer.

It has been a surprise to many that the nails are a source of plastic repair. The nail, however, is only epidermis of unusual thickness, the other pertinent matter being that it depends for life and growth upon its contact at the nail root. Given these conditions, loss in one nail can be replaced by implanting at its root the proper material drawn from another nail. Time and attention do the rest.

Foreign Bodies Not Plastic Material. The tissues do not tolerate foreign bodies but start at once upon the effort to expel them. Only disappointment meets the tentative hope that an exception will be made for gold, silver, ivory or any other substance. The presence of one of them merely makes certain the ultimate break down of the repair. For two reasons, paraffin is the worst. First is its infiltration of adjacent tissue with particles so diffused as to defy removal when the inevitable inflammation is declared. Second is the inexplicable refusal of many to receive the warning of this unvaried experience and be guided by it.

TUMORS OF THE NECK*

SPECIAL REFERENCE TO CONGENITAL CYSTS AND FISTULAS

EDWARD W. PETERSON, M.D.
NEW YORK, NEW YORK

NO other part of the body, with the exception of the abdomen, has so great a variety of inflammatory swellings and new growths as the neck. In its complex embryologic evolution, there are many developmental anomalies. Its anatomy is important, with its definite bony and muscular landmarks; and its complicated planes and partitions of fascia and muscles, enclosing a field overcrowded with vital organs, great vessels, nerves, lymphatics, ducts, etc.

TABLE I
TUMORS OF THE NECK

I. Inflammatory:
  1. Abscess, furunculosis and carbuncle, Ludwig's angina, woody phlegmon, etc. Also anthrax, actinomycosis, echinococcic cyst, etc.
  2. Cervical lymphadenitis (acute and chronic)
  3. Salivary gland inflammations (acute and chronic)
  4. Tuberculosis, syphilis, Hodgkin's disease, leukemia, etc.
II. Embryologic anomalies:
  1. Tumors of the thyroglossal tract
  2. Lateral cysts, of branchial or thymic duct origin
  3. Cystic hygroma
  4. Angioma and lymphagioma
  5. Dermoids and teratoma
III. Neoplastic:
  A. Benign:
    1. Lipoma and steatoma
    2. Fibroma, neurofibroma, ganglioneuroma, etc.
    3. Osteoma and chondroma
  B. Malignant:
    1. Epithelioma and carcinoma
    2. Sarcoma and lymphosarcoma
IV. Tumors of special organs:
  1. Thyroid gland: All goiters, hyperplastic and nodular, toxic and nontoxic, benign and malignant; aberrant thyroid growths; parathyroid tumors
  2. Salivary glands: Cysts and mixed tumors; Mikulicz's syndrome, etc.
  3. Carotid body tumors
  4. Aneurysm of the carotid and subclavian arteries
  5. Tumors of the larynx
  6. Tumors of the esophagus

In an attempt to give a clinical classification of neck tumors, the word "tumor" is used to describe not only true neoplasms, but includes morbid swellings as well. (Table I.)

The diagnosis of neck tumors is not difficult, as a rule, if history, physical examination, and laboratory data are carefully weighed. On occasion, the differentiation does have to wait until sections can be obtained and microscopic study made before a diagnosis can be given. And sometimes the histopathology may be so altered from hemorrhage, pressure, inflammation, or malignant degeneration as to make difficult or impossible a satisfactory report as to the origin and structure of a particular specimen. Occasionally, too, the clinical behavior in a given case may be in conflict with the pathologic diagnosis made at the time of operation. This is especially true of certain goiters, aberrant thyroid growths and salivary gland tumors, pronounced malignant by the pathologist, yet running a benign clinical course subsequently. On the other hand, the benign microscopic appearance of most carotid body tumors may be followed by definite malignancy, after incomplete surgical removal. The pathologist is not so apt, as is the surgeon, to regard these rare growths as malignant. However, all of them should be considered as malignant or potentially so.

Parenthetically, it might not be amiss here, to state that the high mortality and morbidity which follow ligation of the

* From the Department of Surgery, New York Post-Graduate Medical School and Hospital, of Columbia University, New York, N. Y. Read before the New York Surgical Society, New York, N. Y., May 13, 1942.

carotid vessels, necessary in fully one-half of the cases for complete removal of these uncommon growths, can be lessened materially by appropriate preliminary treatment. Every suspected case should have systematic compression of the common carotid artery against the large anterior tubercle of the transverse process of the sixth cervical vertebra several times a day for a few weeks, in order to develop collateral circulation in the brain on the affected side, to avert the danger of death from cerebral anemia and softening, and to avoid the risk of the serious paralyses often present in the patients fortunate enough to recover from operation. This treatment should be kept up until faintness or actual fainting no longer occur when prolonged pressure is made on the common carotid artery.

Extensive neck dissection for tuberculous cervical adenitis was not an uncommon procedure some years ago; while today not only the operation but the disease itself is relatively rare. Better attention to the prophylactic care of mouth and teeth and nose and throat, and an improved milk supply, account for a decline in the frequency of cervical tuberculosis.

Probably more thyroid operations are performed today than ever before. Increased knowledge of the anatomy, physiology, biochemistry, and pathology of this gland, a greatly improved surgical technic, a low operative mortality and the quick relief of troublesome symptoms, all combine to give the thyroid first place in the field of neck surgery.

All surgeons have experienced the difficult, delicate, and often arduous task of extirpating certain neck tumors. Occasionally, however, an agreeable surprise will be met where real trouble was anticipated. The case of a young boy is recalled with a large growth at the angle of the jaw, extending upward and inward so as to displace the tonsil and crowd forward the lateral wall of the pharynx. A preoperative diagnosis of lymphosarcoma was considered and a serious operation was expected. The tumor turned out to be a lipoblastoma which could be shelled out without any difficulty. Another large submaxillary growth, pushing the floor of the mouth and the tongue upward, said by an oral surgeon who had done a biopsy to be a mixed salivary tumor, also proved to be a deep subfascial, embryonal lipoma, the removal of which was accomplished with the greatest of ease. The planned extirpation of a suspected new growth may turn out to be merely the incision and drainage of a deep abscess.

Among the important and serious infections of the neck, demanding the highest surgical skill, are Ludwig's angina, a streptococcal cellulitis of the floor of the mouth and the neck, perivascular infection of the carotid sheath, and diffuse cervical cellulitis. It is being impressed upon us that in the future the management of these virulent infections is going to be influenced favorably by the use of the sulfonamide derivatives.

CONGENITAL CYSTS AND FISTULAS OF THE NECK

The principles and problems concerned in the treatment of congenital neck cysts, sinuses, and fistulas have been understood and taught for many years. Certain operations have become more or less standardized. In spite of this, the percentage of recurrences and failures in the treatment of these lesions is altogether too high even today. Palliative treatment or incomplete operation invites embarrassment and failure; radical excision promises almost uniform success.

Many interesting articles have been written about the embryology and the factors underlying the development of cysts, sinuses, and fistulas of the neck. Probably the most outstanding and generally accepted contribution to this subject, still a controversial one, is the work of Wenglowski, published in 1912. The theories and principles, as set forth by Wenglowski, were given critical examination by Klingenstein and Colp, in 1925, and

by Herbert Willy Meyer, in 1932. Meyer, in elaborate detail, has reviewed and interpreted the whole intricate problem so clearly and logically as to bring order out of confusion, particularly as relates to the branchial and lateral cervical cysts and fistulas. He has called attention to the fact that the beginning of the development of the branchial apparatus in the human embryo takes place in the second half of the first month, and in the course of the second month, sometimes even in the first half, the branchial apparatus disappears completely; that it belongs more to the head than the neck; that the lower border of the hyoid bone forms the lower limit of any branchial remains and any anomalies below this level can have no genetic relationship to the branchial system. Thus any lateral cyst or sinus above the hyoid line might be of branchial origin, any below must of necessity arise from other sources. "This means that almost all congenital anomalies of the neck are not the result of the branchial apparatus, but come from other factors, even though they may have originated from this apparatus."

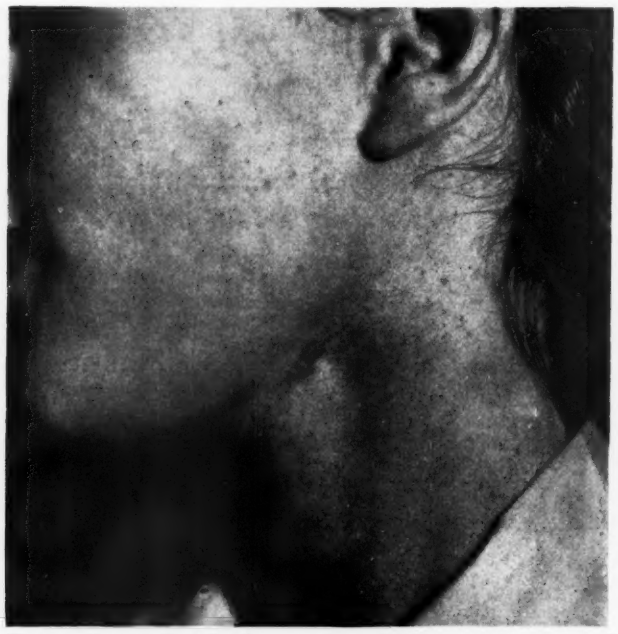


FIG. 1. Case 1. Result three and one-half years after second operation, showing keloid formation in scar.

Bailey has small opinion of the "arm-chair" theorist who airs his views on neck embryology. He has profound respect for Wenglowski, who worked for five years on the branchial apparatus, examining no fewer than seventy-five embryos and 246 cadavers, before profounding his theory. He disagrees with him, however, in his opinion that no branchial remains are to be found below the hyoid level. He mentions cervical auricles and cites the case of a persistent branchial cartilage situated in the lower part of the neck, exactly where a fistula usually opens, as evidence of the incorrectness of Wenglowski's hypothesis. He says "even if I were qualified to do so, it is not my desire to become involved in the intricacies of the embryology of this difficult region. My object has been to approach the subject from the purely clinical side, but I have fostered a hope that by dropping a morsel of truth from the patient's neck into the seething cauldron of controversial cervical embryology, perchance I might help to clarify what is to be served to the student tomorrow."

Meeker objects to the term "branchiogenetic" and says that the human embryo at any stage does not possess structures

that could properly be considered as precursors of congenital cysts of the neck. Many such cysts, particularly those near the angle of the jaw, are considered to be of tonsillar origin, as they are characterized by an abundance of lymphoid tissue in the walls lined by squamous epithelium.

If one accepts Wenglowski's dictum, the cysts and fistulas occurring between the lower hyoid level and the suprasternal notch, along the inner border of the sternomastoid muscle, usually are considered to have arisen from vestigial remains of the pharyngothymic ducts. As a rule they are lined with stratified epithelium with endothelial characteristics: without hair, papillae, sweat, or sebaceous glands. Ordinarily, the thymus canals disappear early and completely, but they may persist throughout life, and, as already stated, thymus rests may form cysts or fistulas. The course of the ducts is from the palatopharyngeal area slightly downward across the space between the ear and the angle of the jaw, then downward and forward and medially, close to the thyroid gland and medial to the margin of the sternomastoid muscle, down to the sternum where they pass into the thymus gland.

Lateral cervical fistulas are present at birth or develop, as a rule, early in life. They may be *complete*, *internal incomplete*, or *external incomplete*. Branchial and lateral cysts form later in life.

Cysts of the neck give rise to but few symptoms, other than the deformity of the tumor, unless infection complicates the picture. After operation (complete excision), healing has been prompt and permanent in all of our cases, seventeen in number, with but a single exception.

CASE REPORTS

Case 1. Sylvia B., age seven, was operated upon at three and one-half years of age, for a sublingual cyst. At age five, she developed a swelling in the left submaxillary region, near the angle of the jaw, which disappeared after roentgenotherapy. Early in October, 1937, there appeared a painless, cystic tumor in the same area that had been treated two years earlier. On October 16, 1937, the cyst was incised by another physician and clear serous fluid evacuated. Active infection of the cyst followed this procedure. She came under our care and was operated upon, October 21, 1937. An oblique incision was made over the area of tumefaction. A small, broken down cyst was dissected from the region of submaxillary salivary gland and upward and outward toward the lower pole of the parotid gland, and posteriorly along the sheath of the great vessels. It was thought at the time that the entire cyst wall had been removed.

The pathologist said that specimen was lined with purulent granulation tissue, with foreign body reaction. However, he was unable to state the nature and origin of the cyst, owing to the absence of a lining epithelium.

The wound healed, but the cyst recurred, and when the patient was readmitted to the hospital, in October, 1938, it was larger than at the previous admission one year earlier. The second operation was performed on October 19, 1938. The old scar was excised. A fairly large cyst with bluish walls was exposed. In the dissection, the cyst was opened inadvertently and more than an ounce of thin, dirty looking fluid escaped. It was found that the cyst went upward and outward to the styloid process, forward and upward to the submaxillary gland region and somewhat downward along the sheath of the great vessels. The cyst membrane was quite thin and appeared to have invasive tendencies, making its complete removal difficult. The wound was flushed out with ether and lightly packed with iodoform gauze. Recurrence was considered probable. However, the healing was slow, but satisfactory, and there has been no further evidence of recurrence after a period of three and one-half years. (Fig. 1.) Again, the pathologic examination was of no help in settling the question as to the nature and origin of the cyst. The impression at the time was that it was probably of branchiogenetic character, but in view of the record the exact diagnosis is still a matter of conjecture.

One case of pre-auricular branchiogenetic sinus, not included in this series, too, required a second operation before healing occurred. It would be gratifying to be able to include the report of a successful operation for branchiogenetic carcinoma, but again, unfortunately,

the pathologist was unable to determine the origin of a primary malignant tumor, removed from the submaxillary region, near the angle of the jaw and above the level of the hyoid bone. The patient was followed and remained well for nearly ten years, then was lost sight of.

A B

FIG. 2. Case II. A, congenital fistula of neck before operation; B, result after operation.

The cysts and fistulas of pharyngothymic origin are apt to exhibit recurring attacks of infection and inflammation. Generally, there is an intermittent, sometimes a continuous discharge of secretion, from the external fistulous opening. Another symptom mentioned by some authors is an unexplained cough due to vagus nerve involvement. In order to cure such a fistula, usually associated with a cyst somewhere in the canal, it is necessary to excise the entire duct from the external opening up to the wall of the pharynx.

CASE II. Robert G., age seven, was admitted to the Post-Graduate Hospital in December, 1938. At birth, an opening not larger than a pinhead was noted in the right sternoclavicular region of the neck. On admission, it appeared as a reddened, raised, indurated, circumscribed lesion, with an opening in its center. A palpable, movable, cord-like structure could be felt along the border of the sternomastoid muscle. There was a history of repeated attacks of infection and intermittent, mucopurulent discharge from the fistula. Attempts to inject fluid through the fistulous canal were unsuccessful. Apparently, the anomaly was of the external incomplete variety. The operation was performed December 19, 1938. An incision including a small amount of skin was made around the external opening and carried upward along the margin of the sternomastoid muscle. The duct was easily freed until it passed under the posterior belly of the digastric muscle. By blunt dissection it was isolated up to the wall of the pharynx. A probe was introduced into the duct and its blunt end pushed through the posterior pillar of the fauces into the mouth. A short stump of the duct was then anchored in the eye of the probe and inverted into the mouth, after the method of von Hacker, and removed completely. Thus the whole of the thymus duct was dissected out. The wound healed promptly and the patient has remained well since the operation. (Fig. 2.) Pathologic diagnosis: pharyngothymic cyst and fistula, external incomplete type.

Dr. R. Franklin Carter has operated successfully upon a case of bilateral congenital fistulas of the neck. (Fig. 3.)

Comment. The stepladder method of Bailey gives a better cosmetic result and should be used, especially in females, in order to obtain inconspicuous neck scars. (Figs. 4 and 5.)

Thyroglossal Cysts and Fistulas. The embryology of the thyroid gland seems less complicated and the factors underlying the development of midline cysts and fistulas are better understood and less controversial than the branchiogenic and lateral cervical lesions. The midthyroid anlage maintains its upper connection with the foramen cecum through the thyroglossal tract, and the foramen cecum is the rem-

nant of the spot where the anlage developed. Toward the end of the second month this thyroglossal tract is separated into upper and lower divisions by the developing hyoid bone. The lingual ducts are not a part of the thyroglossal tract, in fact, there is no thyrolingual duct or canal. The midline growths form along the thyroglossal tract, which *has no* lumen. There are two types: (1) Epithelial tubes or cysts, from which the ordinary midline cysts arise, and (2) the thyroid tissue rests, which may be the cause of abnormally located goiters. When a midline cyst, as a result of infection and suppuration, opens externally on the skin, it becomes a sinus, but *never* a complete fistula. In this respect it differs from the pharyngothymic ducts, from which fistulas complete and incomplete, may arise. There is little difference between cysts and fistulas seen in the thyrohyoid region, for by obliteration of its opening, a fistula may become a cyst, and suppuration in a cyst may cause rupture and transform the cyst into a fistula.

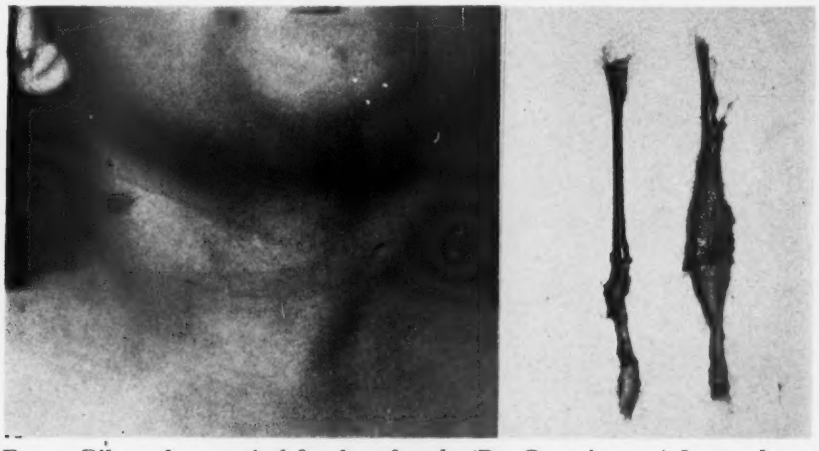


Fig. 3. Bilateral congenital fistulas of neck. (Dr. Carter's case.) Insert shows the ducts removed at operation.

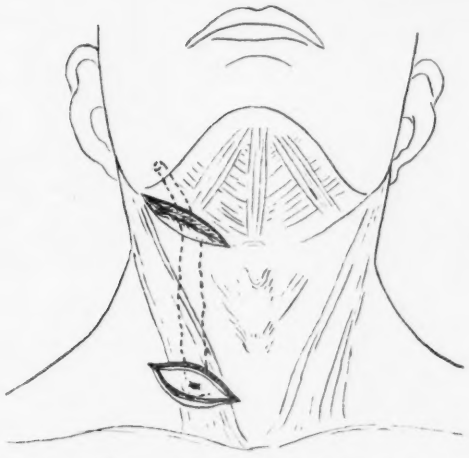


Fig. 4. Shows the parallel incisions in the Bailey step-ladder operation for congenital fistula of neck.

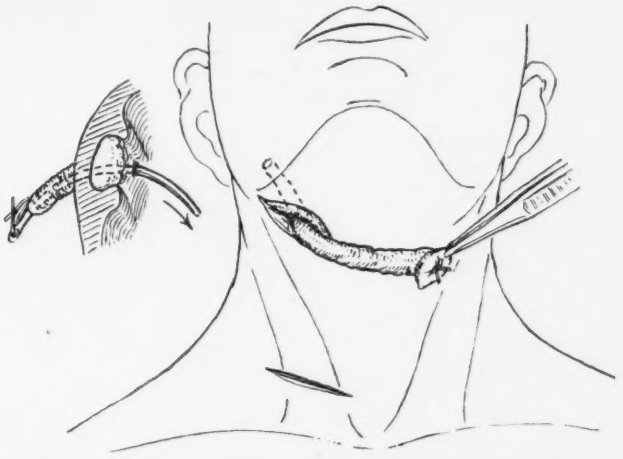


Fig. 5. Shows a continuation of the Bailey operation. The duct is dissected up to the wall of the pharynx and there cut off. Insert shows the von Hacker method of inverting the stump of the duct into the mouth.

A thyroglossal cyst which has discharged its contents spontaneously or by incision, has a corrugated lining, and may have minute channels or burrows extending into the surrounding tissues for some little distance. If overlooked and unrecognized

during attempts at radical excision, failure of the wound to heal completely and recurrence of the sinus are to be expected.

watery, glairy and mucoid, or purulent, but it is seldom profuse or continuous.

In 1920, Sistrunk published a method of

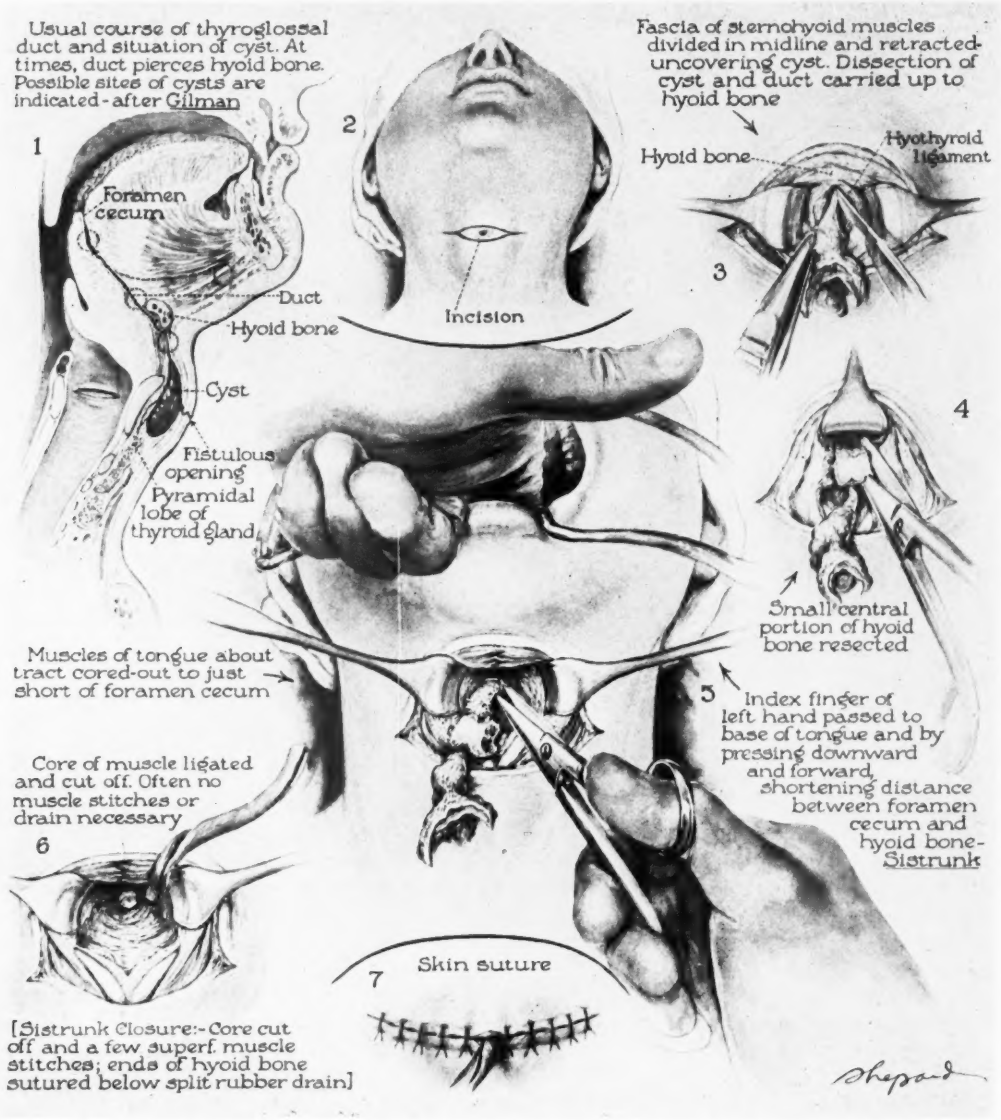

Usual course of thyroglossal duct and situation of cyst. At times, duct pierces hyoid bone. Possible sites of cysts are indicated - after Gilman
1
Foramen cecum
Duct
Hyoid bone
Cyst
Fistulous opening
Pyramidal lobe of thyroid gland
2
Incision
Fascia of sternohyoid muscles divided in midline and retracted uncovering cyst. Dissection of cyst and duct carried up to hyoid bone
Hyoid bone
Hyothyroid ligament
3
4
Small central portion of hyoid bone resected
Muscles of tongue about tract cored-out to just short of foramen cecum
5
Index finger of left hand passed to base of tongue and by pressing downward and forward, shortening distance between foramen cecum and hyoid bone - Sistrunk
Core of muscle ligated and cut off. Often no muscle stitches or drain necessary
6
7
Skin suture
[Sistrunk Closure:- Core cut off and a few superf. muscle stitches; ends of hyoid bone sutured below split rubber drain]
Shepard

FIG. 6. Shows the steps in the removal of the whole thyroglossal tract in the operation for thyroglossal cyst or sinus. (Courtesy of Johnson and Johnson.)

The disfigurement of a thyroglossal cyst is not very noticeable, unless the tumor is large. The symptoms which usually cause a patient to consult a surgeon are recurring attacks of inflammation or a discharging sinus. Pain is not an important symptom, except during the periods of active infection. Discharge from the sinus, as a rule, is intermittent and slight, except when activated by infection. The character of the discharge varies: it may be clear and

complete removal of the whole epithelium-lined thyroglossal tract for the cure of midline cysts and sinuses. Before the adoption of his method results were uncertain and recurrences were frequent. After this radical procedure recovery is the rule and failure should be exceptional.

The technic of operation is as follows: A transverse incision is made over the cyst or a transverse elliptical incision is made around a sinus opening. Skin and platysma

muscles are reflected. The cyst or sinus is dissected free up to the hyoid bone; 1 cm. of the central part of this bone is resected, and then without any attempt to isolate the strand, the tissues surrounding it are cored out up to the foramen cecum. The direction from hyoid bone to foramen cecum, corresponds to a line drawn at angles of 45 degrees, backward and upward, through the intersection of lines drawn horizontal and perpendicular to the superior central portion of the hyoid bone. The cyst or sinus, a portion of the hyoid bone, a portion of the raphe joining the mylohyoid muscles and a portion of geniohyoglossus muscles are removed up to the base of the tongue. A forefinger pressing downward and forward against the foramen cecum shortens the distance and aids in the correct line of dissection. The geniohyoglossus muscles are brought together with a few sutures, the resected hyoid bone needs no attention, and the skin can be closed with clips. It is best to leave a small tube or tissue drain. (Fig. 6.)

Since the adoption of the Sistrunk operation, with only slight modifications, we have had on our service at the Post-Graduate Hospital, fifty-three cases of thyroglossal cysts and sinuses, operated upon by Dr. R. Franklin Carter and the author. The cases were scattered over a period of about twenty years. For fourteen years there were uniformly successful results. In 1934, an operation was performed upon a young girl, who had already had three previous operations for a thyroglossal cyst and sinus. The typical Sistrunk procedure was carried out, but the wound did not heal and a sinus persisted. The patient was taken to the Long Island College Hospital, and was operated upon successfully by Dr. Arthur Goetsch. A short time later another wound failed to heal, but we performed a secondary operation six weeks later, with a successful outcome. A little later, another patient, operated upon fourteen years previously, and well until two months before, developed an abscess and a thyroglossal sinus. Here, too, a second operation was entirely successful.

Case III. Lillian W., age six, was operated upon December 23, 1924, for a thyroglossal cyst, about the size of a hazel nut, noticed for two years. Radical removal of the cyst, a portion of the hyoid bone and the tract up to the foramen cecum was done. The patient remained well for over fourteen years.

May 1, 1939, the patient was again operated upon for a thyroglossal sinus, which had appeared two months before. The radical procedure of Sistrunk was repeated. The wound healed promptly, and the patient has remained well for three years.

Why did the first two cases fail to heal? It is probable that in both instances some small tract or burrow was overlooked. How about the recurrence after fourteen years? Some cell rest along the tract must have become activated, followed by the formation of a new cyst and later by infection, suppuration, and sinus formation. Meyer states that the "recurrence of fistulas may be due not to an incomplete operation, but may be a cropping-up of a further normal cyst, that had not enlarged, but which, secondarily, later became inflamed and then enlarged and broke through the old scar, the place of least resistance."

Cystic Hygroma of the Neck. Hygroma may occur in locations other than the neck—in the axilla, the groin, and retroperitoneally—but the neck is the most common site. It is a thin-walled, multilobar, multilocular, benign, neoplastic, cystic growth, lined with endothelium characteristic of lymph spaces, and arising from sequestrations of lymphatic tissue, derived from the primitive jugular sacs, which have failed to join the lymphatic system in the normal manner (Goetsch). There are, as a rule, no local or constitutional symptoms, unless the deformity or disfigurement of the growth be considered as such. Sometimes a hygroma may be rapid in its growth and cause pressure on important structures, such as the larynx,

trachea, nerve plexuses, etc. When it grows from the neck down into the chest cavity it may cause marked respiratory

Goetsch believes that palliative treatment, such as incision and drainage, and the injection of sclerosing solutions, are

FIG. 7. Case IV. Cystic hygroma of neck. A and B, before operation; C and D, four years after operation.

embarrassment. The larger growths are prone to become infected and such infection may result in grave constitutional symptoms, even death; rarely, it may be followed by a spontaneous cure. Infection gives such a high mortality that few surgeons can point to successful results, other than by radical surgical extirpation. Operation should be undertaken early, before the invasive and peculiarly destructive action of this growth, benign in its histology, but malignant in its potentialities, make complete excision impossible or the attempt inadvisable.

not only futile in effect, but they may cause dangerous complications. Even simple aspiration is far from being a safe diagnostic procedure. Irradiation, too, has given indifferent results, but is recommended as advisable in the large hygromatous growths in infancy, as a preliminary measure to complete surgical excision, which is requisite for a cure.

CASE IV. Thomas O., age four months, was admitted to Babies Wards of the Post-Graduate Hospital, April 4, 1938. A thin-walled cystic tumor, below and behind the left ear, was present at birth. It caused no symptoms, but

was growing slowly, and caused deformity and distortion of the external ear. At the time of admission it was 6 by 4 by 4 cm. in size. It transmitted light readily when examined. It was aspirated and found to be multilocular and to contain watery fluid. Aspiration was followed by some hemorrhage into the growth and later by active infection, which delayed surgical treatment for a time.

On April 8, 1938, an oblique incision was made below and parallel to the margin of the lower jaw and carried up behind the ear and over the mastoid region. A multilocular cystic mass, closely attached to the ear, and invading the parotid gland was dissected out. The operation was a delicate but not a difficult one. The wound was drained owing to the recent infection. Healing was slow, and more than once small collections of pus had to be evacuated from the wound. The final result appears satisfactory. (Fig. 7.)

Pathologic examination: Gross: The single specimen 4 by 3.5 by 2.5 cm., was a soft, friable, irregularly pyramidal mass. The outer surface was ragged with hemorrhagic connective and muscle tissue. On section, there was a network of gray connective tissue of varying density and thickness. The spaces between the meshwork were filled with clotted blood as well as with blood-stained clear watery fluid.

Microscopic: The basic structure recognized in several sections was that of a system of blood spaces. The endothelial lining of the blood spaces was not everywhere recognized, but the smooth muscle of the walls was easily seen.

Many of the blood spaces were greatly dilated and filled with whole blood. Others were obliterated by granulation tissue of varying maturity in which there were mononuclear cells containing brown pigment, probably hematogenous. This represented the organization of thrombi. In many places the connective tissue was firm, poorly cellular, dense, and markedly hyalinized. In such scar-like tissue, there were foci of lymphocytes. At the periphery of the specimen the striated muscle and areas of hemorrhage, probably operative. Here, too, there were areas of well preserved salivary gland, probably parotid. Pathologic diagnosis: cystic hygroma.

SUMMARY

The clinical classification of neck tumors shows the large number and the wide variety of these growths. The general remarks were intended to call attention to points of interest in connection with selected cervical lesions.

The subject of congenital cysts and fistulas has been given special consideration. The clinical aspects, principally, have been discussed, based on an experience with seventy-one of these cases, over a period of about two decades. Some of our problems have been related, in order to give emphasis to the well understood principle of complete surgical excision, which is the essential factor in bringing about a cure.

REFERENCES

1. Bahley, Hamilton. *Brit. J. Surg.*, 21: 173, 1933.
2. Goetsch, Emil. *Arch. Surg.*, 36: 394, 1938.
3. Klingenstein, F. and Colp, R. *Ann. Surg.*, 82: 854, 1925.
4. Meeker, L. H. The Laryngoscope. March, 1937.
5. Meyer, H. W. *Ann. Surg.* 95: 226, 1932; *Arch. Surg.*, 35: 766, 1937.
6. Sistrunk, W. E. Surgery, 71: 121, 1920; *Surg. Clin. North America*, 1: 1509, 1921.
7. Wenglowski. Quoted by Klingenstein and Colp,[3] by H. W. Meyer[5] and also by Hamilton Bailey.[6]

KNOW YOUR PATIENT*

JEROME MORLEY LYNCH, M.D.
Diplomate of the American Board of Surgery
NEW YORK, NEW YORK

HISTORY taking is important in that it gives you a chance to study your patient. As he unfolds the symptoms of his disease, it gives you some idea of his background. The age at which his grandparents and parents died, give you some idea of his structure, and structure is very important. The type you are dealing with gives you an insight into his outlook and reactions, but perfection in structure is another question. Two houses may look like duplicates, but the material employed may be very different.

Aging reaction is probably due to some secretory imbalance, slowly altering the internal constitution of the individual. In some people this change is almost imperceptible, while in others it is pronounced. Those changes are not characteristic of any one type, but are due to his structural inheritance. This theory is in keeping with our belief that structural deficiencies are Mendelian.

Surgical and medical treatment alone are not always sufficient or satisfactory unless you have some inkling of the psychology of the person you are dealing with; but if you can give the patient some information about his background and reaction, you will fix his confidence in you and make the subsequent surgical and medical treatment much easier. It pays to take time and patience so that you may gather all the information you can while apparently being interested only in the patient's history.

Within the last twenty-five years the laboratory has made the approach to diagnosis much simpler, but at what a price! It is like the navigator, instead of working out a problem with pencil and paper, he turns several wheels, looks at the back, and finds the answer to his question without understanding how he got there. It is much more interesting to spend a little more time studying your individual and using the laboratory only to check up on your diagnosis.

We measure the existence of everyone from birth to death. As a matter of fact, the most important period of existence is past when the person is born. The chances of maladjustment are numerous during fetal life. Deprived of water, oxygen, or food, for even a short time, may have very bad effects during intra-uterine and postnatal life. This is comparable to a noxia in postnatal life.

Nature is very exacting. Every organ and part of the body has the advantage of position at some period or other, and if it loses this, it never gets a second chance. In early fetal life the liver has the advantage of position until it has attained its full growth. As the abdominal cavity does not keep pace with the development of the liver and as two bodies cannot occupy the same space at the same time, most of the intestines remain outside of the abdomen until the liver has attained its full growth and then as the belly rapidly grows, the intestines slip into the abdominal cavity and finally the cecum and appendix cross the duodenum and rest over the right kidney, a position which is permanent in the dog. After birth the cecum gradually migrates into the iliac fossa, where it squats and as the result of a physiological peritonitis is permanently fixed in this position. Failure of this to occur results in a non-fusion of the mesentary, allowing 180 degrees rotation of the cecum. This is not

* The Biennial Joseph M. Matthews Oration delivered at the American Proctologic Society Meeting, Atlantic City, June 7, 1942.

the only abnormality. Elbow deformity may aggravate this condition. Failure of the cecum and appendix to cross the duodenum and arrive in their proper positions, may result in non-fixation of the appendix on the left side.

Several recent studies have tended to indicate that human beings may be divided into groups or types according to their structural organization. Bean, who has studied racial types extensively in several parts of the world, has laid particular stress on the thin epithelial type and the robust connective tissue type. The first, or hyperontomorph, is a lank individual found to possess a long vertical stomach, short small intestine, and a long large intestine and small liver. The second, meso-ontomorph is fat and broad in general appearance with a large transverse stomach, a small intestine and a short large intestine. Each type, Bean believes, may be prone to a particular disease which occurs only rarely in the other type.

Stockard, studying from an entirely different standpoint, believes two chief types of individuals exist and that the one group differs from the other on account of having undergone its early postnatal development under a different complex of the internal secretions. The two types in the end correspond with Beans—the linear type being an individual that has had a high physiological thyroid bringing about early differentiation of organs and parts without excessive growth in size. The meso-ontomorph as a child had a low active thyroid, grew large in size, particularly in width, but its organ differentiation was slow. There are a number of correlated characters presented by individuals of characteristics shown by the other type.

Therefore a hyperontomorph or high thyroid type, would be mentally precocious and physically frail. He would have a vertical stomach; the small bowel would be subject during early childhood to alimentary disease. Certain ones of this type would have an acute costal angle, a long narrow chest, and a very active nervous system. On the contrary, a low thyroid type, or meso-ontomorph, would be physically well developed, have a transverse stomach, the small bowel would be very long and the large bowel very short. He would have a good digestion and metabolism. Interpupillary distance is short in the linear type and long in the lateral type. Linear types are farsighted and lateral types, nearsighted. The arch of the mouth is high in linear types and short in the others. The linear type is always underweight for its size and between twenty and forty may not vary more than a few pounds, whereas the lateral type may be overweight and gain or lose fifteen or twenty pounds. The linear type has a large larynx and a baritone or bass voice, whereas the lateral type is usually tenor, having a small larynx. The linear type is full of ideas but is too nervous to work them out. The lateral type loves detail (and seldom has an original idea).

It is apparent that if a patient has a long narrow chest and an acute coastal angle, that the most suitable position for his stomach is vertical, and any surgical alteration will be unfortunate. It is, therefore, fundamentally incorrect to try to convert this congenital type into something altogether different. This applies with equal force to the position of the colon. Plication here would be just as ineffectual as in the matter of the stomach. In fact, fixation of organs that should be movable is a surgical error. On the other hand, the fixation of movable organs that belong fixed is surgically correct.

The alimentary canal is the one single system in the body. All others are bilaterally symmetrical. Are there compensations for the apparent deficiency, or does it mean that nature has felt this the oldest of all the systems to be so perfect as to be sufficient to the economy as a single unit? Has this interesting phenomenon any pathological significance? Does the length of the canal offer any explanation of its efficiency and what bearing, if any, has the fact that the diameter varies directly

with its length? Can any deductions be drawn from the fact that the pars pylorica is well developed long before there is evidence of any fundus? May not priority in origin point to priority in function? Has not the very fact of its amazing efficiency a bearing upon the well known law that as an organism approaches perfection it tends to self destruction?

In its extreme age, in its refinement of function, we may perhaps seek for some of the fundamental causes of its variations from the normal and for the resultant known generally as intestinal toxemia.

Like the many sects in medicine, each one of which sees truth through its own narrow slit, so also has the subject of intestinal toxemia. Some have considered it a mechanical condition pure and simple; some a neuromuscular one; some a disturbance of internal secretions; some as arising from a vasotonic disturbance; some a psychosis; some, like Adami, consider it a subinfection; some, like Combe, a hydrolytic process of bacterial origin. Non-partisan students are at a loss in seeking the truth from among this maze of authoritative statements.

One thing at least is clear, viz., that the causes are either exogeneous or endogeneous. The factors operating from without, like misplacements, displacements, obstructions, and bacteria which hydrolyze proteins within the lumen are totally separate and distinct from those of a biochemical nature which probably have their origin in the disturbed conditions in the cells of the intestinal epithelium itself and are probably endogeneous.

What part does the modern surgeon play in this complex problem? To our mind a very large and increasingly important one.

In 1916, I stated that the physiological surgeon would be the internist of the future. This view is not held without dissenting voice, for the general conception of the surgeon's place in the therapeusis of the canal, aside from the treatment of acute conditions, is that he may occasionally be of use to remove mechanical obstructions which cause constipation. Popularly this condition is known as stasis. We hold that this term is an unfortunate one because it implies mechanical rather than biochemical or physiological considerations, which seem to the essayists of far greater importance. This is not a plea against the mechanistic school which plays its important part, but fortunately surgery is no longer divorced from the sciences, having become an integral part of them. Thus its votaries will give great help in determining the etiology and therapeusis of the non-obstructive, non-static intoxications, in many of which surgical intervention alone avails. This means only that the diagnostician must now think in terms of both medicine and surgery.

The pathology of adolescence begins in utero. Until birth the child's future is predestined by the forces of nature. In childhood much can be done to correct congenital alimentary defects; at maturity, the individual to a great degree shapes his own career, quite aside from the limitations of his inheritance and environment. Thus there are three periods: the first, over which we have no control save through eugenics and this is uncertain, as mediocrity is always rampant; the second, over which an increasing control will be gained through increasing knowledge of child hygiene and therapeusis; the third over which control will be gained in direct proportion to the acquisition and diffusion of the truth regarding etiology, diagnosis, and therapeusis. Out of this vast field we have chosen to discuss in detail a few factors relating to the third.

Formerly, we looked upon the stomach as a receptacle which prepared food for digestion. Now we know that it has other important functions most essential to life.

The pyloric gastric glands secrete an intrinsic substance which, acting on an extrinsic substance in the food, produces a third factor known as erythrocyte maturing factor, which is necessary to the maturation of the red blood cells in the

bone marrow. Furthermore, the hydrochloric acid secreted by the fundus of the stomach, helps in the absorption of iron and probably has other functions besides.

It is a specialized morphological adaptation, useful but not essential. Similarly the cecocolon prepares the food for dejection. Who among us has not seen colectomized men and animals remain in perfect health, all diarrhea being controlled through the assumption of colonic function by its embryological prototype, the terminal ileum?

Even more significant is the fact that broken health has unquestionably been restored in human beings after partial or complete resection of the colon. It is far from our intent to argue that these organs have no function, for it is well known that along with all other groups of specialized cells, those of the stomach and colon must normally play an important part in balancing metabolism.

To complicate the problem of surgical diagnosis and therapeusis further, there are compensatory properties inherent in the alimentary canal just as truly as in the heart. A resected stomach may in part reform; an iliac segment transplanted into a colon will shortly assume both the size and in a measure the function of the colon, with the exception of anastalsis and ascending currents in mucous canals; a terminal ileum upon which, by the operation of ileostomy, the function of a colon is suddenly thrown will vicariously assume colonic function after a certain period, both as regards water absorption and fecal storage and dejection; an intestine will thicken oral to an obstruction and in proportion to the load, until, as in the heart, overload begets atony and dilation.

Thus it is more than ever clear that in the alimentary canal we are dealing with a system which, in part due to asymmetry, in part to extreme antiquity, and to the persistence in it of primordial zymotic reactions long dormant and now superseded by the nervous system, is endowed with many functions a few of the grosser of which are known, but most of which are utterly unknown. It is a system subject to the utmost variations of form due to both hereditary and to environmental conditions, and which save the brain, finally is the seat of the most complicated derangements of any part of our bodies.

Of the symptoms traceable to this canal one great surgeon has said, "We know so little as to their origin and treatment that we should consider ourselves the fools rather than the neurasthenic patients whom we seek to relieve."

Diagnosis of Adult Conditions. The diagnosis of adult intestinal toxemias has as its basis the cardinal symptoms of diarrhea and constipation. These conditions have been treated empirically from time out of mind, so that it is next to impossible to get either physician or patient to look upon them as symptoms rather than as entities. But progress demands it. As the modern physicist is showing that the supposed elements are really manifestations of a single basic ion and, therefore, not in a true sense elemental, so must we modern physicians realize that the ancient disease entities which we have been taught to believe in, are often not elements but are simply symptomatic, superficial and almost always protective manifestations. They are far more numerous than the sixty-odd old chemical elements, being the variable outward expressions of a fundamental disturbance of metabolic equilibrium and of nature's efforts to heal.

It is the old story of the objective method as opposed to the subjective, of function versus form, of biologic laws opposed to empiricism. It is significant that a true interpretation of symptoms has been the best means of improving therapeusis. We are, at best, only beginning to understand that most symptoms are protective and should be encouraged rather than suppressed until the true cause of the underlying disturbance has been found.

There is no field in all medicine more vivid with the truth of all this than that of the diarrheas. Let us urge that all diar-

rheas and constipations be looked upon as due to an exogenous cause until proved to be endogenous. Exogenous causes are either congenital or acquired. In our experience failure of fusion and departure from the normal migration of the cecocolon play a more important part than the acquired conditions, for they are transmitted by the same laws of heredity which govern transmission or other dominant characteristics. The common mesentery which results from non-fusion may permit of 180 degrees mesodorsad rotation upon adventitious bands which often support a cecocolon from the parieties constricting the ascending colon and causing a tadpole-like deformity with intermittent partial obstruction, as occurred in one of our cases recently. Such bands are doubtless manifestations of nature's efforts to compensate for the hereditary deficiency. No more potent argument is at hand in support of extensive undergraduate study of comparative anatomy and of research surgery on the lower vertebrates than this. For every graduate should know that from a common ancestor we may inherit departures from our conception of the normal; as for instance, a mobile duodenum or mesogastrium, such as are found in the dog, non-rotation, non-fused mesentery, an herbivorous type of cecum, infantile cecum, megacecum, absence of sigmoid (quadrupeds have no sigmoid according to Henscher and Bergstrand in Ziegler's Beitraege 56, 1913) or of cecum, and a host of other variants, explicable only by heredity.

The teaching of these fundamentals seems to us of far greater use than an ingrinding of the pharmacopoeia or of descriptive anatomy.

Bayliss and Starlings "Law of the Intestines" or myenteric reflex is of great importance in the surgical physiology of the alimentary canal. It consists in the production of a relaxation with inhibition of movements aboral to the spot at which a mass of food is collected and an increase of tone together with more powerful contractions oral to the spot, thus moving the contents onward.

We have for years contended that death from duodenal or jejunal obstruction is due to an interference with the internal secretory function of the epithelial cells of the gut itself rather than to bacteriotoxic causes. Now, if this is true of complete obstructions, what diversity of symptoms may not be caused by incomplete obstructions occurring at different levels! Doubtless the complexity of duodenal enzymes or hormones is much greater than that of any other part of the canal, though the subject is far from settled as to details; and this may explain the relative gradation of symptoms and the well known fact that their intensity varies as the square of the distance from the duodenum or thereabouts. Moreover, what has been accepted for the duodenum may be true also for the colon. This at least affords a working hypothesis to explain the immediate relief from certain of arthritides, as occurred in one case of our series after developmental reconstruction.

We are not sufficiently advanced in a knowledge of the internal secretions to say how important a disturbance of these may be in the colon, nor, indeed whether they exist; but if we are to believe Pick, even the lowly connective tissue cell of the colon secrets an enzyme called tryosinase. Furthermore, this matter of internal secretion of the gut may have an important bearing upon the phenomena which we have noted after ileostomy when there occurs a most marked change in the physical well being of the patient, as sudden and as profound as we have noted in the arthritides after colonic reconstruction. We have also noted nature's effort to compensate from any imbalance that may result from this operation by causing a marked dilatation and thickening of the cephelad illeum and the contraction and shrinkage of the excluded portion of the bowel to the size of a pencil.

Previously the clinical changes observed after this operation have been explained

wholly on the ground that the proteolytic anaerobic bacteria were unable to thrive on the acid media of the terminal ileum, and it is on this assumption that Metchnikoff popularized the value of the fermented milks. Here may be another point of similarity between the physiological mechanism at the beginning and end of digestion. The acid contents of the stomach are poured into the duodenum, so also are the acid contents of the ileum injected into the cecum. This mechanism works well in the absence of malignancy, but when malignancy occurs in either of those situations, some poisonous substance is evidently developed which is probably responsible for the primary anemia. A histotoxic anoxia may be the explanation.

It is accepted that a definite number of patients who suffer from the syndrome of intestinal toxemia, have been benefited or cured by operation, after other methods have been tried. What are the procedures which have been in general use? First, ileosigmoidostomy; second, cecosigmoidostomy; third, appendicostomy; fourth, ileostomy; fifth, plication of the cecocolon and repair of the cecal valve; sixth, total "colonic exclusion"; seventh, colectomy; eighth, developmental reconstruction or right ileocolectomy. The very multiplicity of procedures is in itself a certain index of our ignorance.

Ileosigmoidostomy has undoubtedly benefited a goodly number of cases. But what are its drawbacks? We have shown that a dominant anastalsis is often the physiological basis for the symptom constipation. All operations must be planned so as to minimize the effects of this symptom of aberrant physiology and if possible to counteract it. The foremost advocates of this operation admit that because of anastalsis in 10 per cent of cases a subsequent colectomy is a necessary corrective measure. Further, although we may learn to recognize sigmoidal anastalsis before operation, who can say that it may not develop as a result of this operation itself? The technic, therefore, has a much higher mortality than is ascribed to it because of these secondary complications, and is rightly falling into disuse, except as a procedure prior to colectomy.

Cecosigmoidostomy is deficient both theoretically and in practice. Its employment leaves out of consideration the law to which we have referred, viz., that intestinal contests tend to follow the normal direction of the canal, irrespective of lateral stomas. Occasionally, nature performs its own anastomosis in order to insure continuity and overcome obstructions. We have seen this in several instances when operating for carcinoma of the sigmoid. Some loops of the small intestines became attached to the tumor, causing obstruction and the obstruction was relieved after nature succeeded in making a new opening that side-tracked the tumor.

Appendicostomy is safe though insufficient in most cases. One important fact in its favor is that it places the stoma oral to the entire colon. This is in keeping with our observations, viz., that a stoma to be effective must be oral to the infected area. This is very useful following the Lynch operation and in some cases of nonspecific ulcerative colitis.

Illeostomy. This procedure first intentionally employed in this country by us has limited and definite indications, but is of proved worth when indicated. It was devised and employed by an Italian some forty-five years ago.

Plication of cecocolon may benefit, but it is questionable whether the results are premanent, and this coincides with our animal experimental work. The technical defect may be that the co-aptation is peritoneal rather than muscular.

Colectomy has a place but it is a small one, because of the high mortality, but is indicated in diffuse polyposis, papillomatosis, diverticulitis, and in certain malignant tumors, and segmented infection of the colon.

Of the many operations which have been suggested, that of developmental recon-

struction has proved very satisfactory in certain carefully selected cases. The writer has applied this term to the ordinary operation of resection of the terminal ileum, the cecocolon, and the oral part of the transverse colon, because it exactly describes the procedure. The colon is reconstructed to the primitive or developmental type seen in the adult dog, or in the human fetus just following rotation, the great gut beginning in the right hypogastrium, there being no true cecum or ascending colon. We have believed that there may be a definite relationship between the symptomatic improvement in human beings after developmental reconstruction, and the fact that more primitive forms, like that of the dog, are free from colonic disease. We have called attention to the fact that this last formed portion of the colon is more liable to disease than the older aboral portion.

As in the case of other organs which have become diseased and dangerous to the economy, this organ, its function destroyed, should be removed.

One word in regard to colonic vaccines. There is this to be said in favor of the vaccine treatment: That it usually helps; it is free from danger, and if an operation becomes necessary subsequently, it places the patient in the best possible condition to withstand it. It is valuable postoperatively.

Rectal feeding has long been a satisfying and comforting necromatic rite. It was ancient history when Hippocrates was a boy. Of all the delusions of grandeur ever inherited by the profession this was the most mythical.

At least, however, we have arrived at something definite, viz., the use of amino acids. Urinary studies prove this. These final products of protein digestion occur in the blood, dialyze readily, and are the logical postoperative sustaining agent of the future.

One cannot consider the field of colonic surgical therapeusis without being convinced that the future holds out great things, and perhaps the greatest of these is the hope that physiological surgery collaborating with medicine may help us to find the true cause and cure of many troubles which now seem obscured.

FRACTURES OF THE MANDIBLE*

REPORT OF FIFTY APPLICATIONS OF THE ROGER ANDERSON SKELETAL FIXATION APPLIANCE

LEO WINTER, M.D.
Surgeon in Charge of Oral Surgery, Bellevue Hospital; Professor of Oral Surgery, New York University College of Dentistry
NEW YORK, NEW YORK

THE use of skeletal fixation in traumatic surgery is one which, in principle, has existed since the start of the century. Its application in the past has been limited to use by the orthopedic surgeon. The development and embellishment since its conception has been considerable.

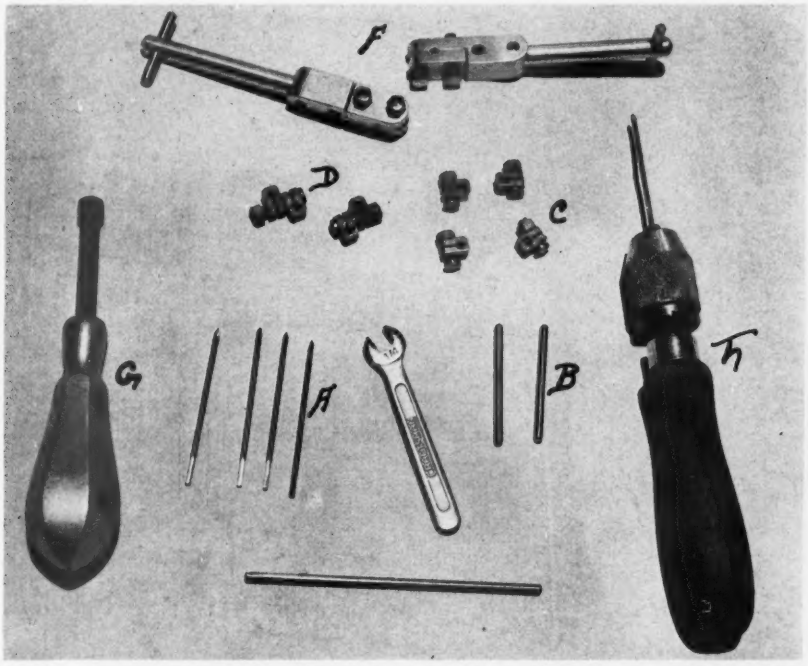


FIG. 1. Roger Anderson Appliance: A, B, C, Universal Frac-sure unit; A, pins; B, rod; C, clamp; D, fixation clamps; F, manipulatory connector; G, wrench; H, wrench for insertion of screws; horizontal part at bottom of illustration is the fixation rod; directly above fixation rod is a right angle wrench.

The use of pins or screws in bone surgery has, from its earliest application, been confronted with a "pin phobia" on the part of the profession.

With the advent of war and the ensuing injuries and problems of treatment, evacuation, transportation and repair that ensues, there exists the need for a rapid and efficacious method in the reduction and immobilization of fractures. This applies not only to those of the long bones but equally to that of the mandible, wherein if there is failure to introduce early reduction and immobilization, lifelong deformities will of necessity result. Further demands along these lines will include the treatment of shock and hemorrhage which are resultant from injuries to the facial tissues and underlying bony structures. It has long been recognized that the best treatment for

* From the Department of Oral Surgery, New York University and Bellevue Hospital.

shock is its prevention; the earlier that treatment is instituted, the more rapid and more likely are the prospects for early and uneventful recovery. With this thought in mind the fundamental concept to be considered in the treatment of mandibular injuries is to have an efficient method available which will satisfy the physiologic needs of the individual as well as the functional and esthetic demands. This calls for early reduction and immobilization with a minimum of complicated equipment that can be applied whether it be the dressing station, field hospital, evacuation hospital base, or on shipboard.

Doctor Roger Anderson, of Seattle, has further modified and developed the early principles of pin fixation with an apparatus to simplify the technic of reduction and insure maintenance of immobilization. The appliance which Anderson employed in the treatment of fractures of the long bones has been modified and reduced to a smaller size so as to allow for its application in treatment of fractures of the mandible. (Fig. 1.)

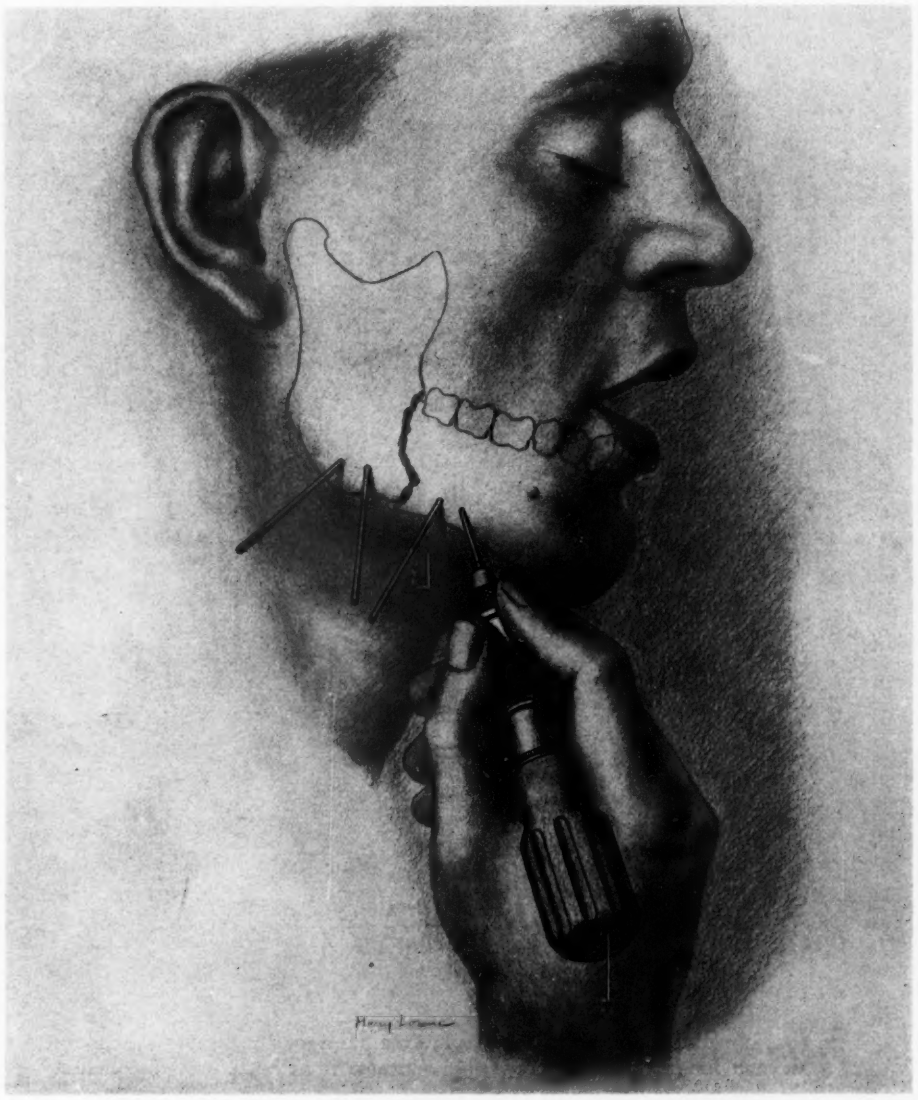


FIG. 2. Insertion of pins in Roger Anderson skeletal fixation for fracture of body of the mandible with elevation of the posterior fragment.

ANATOMY

The treatment of fractures of the mandible cannot be fully understood without a

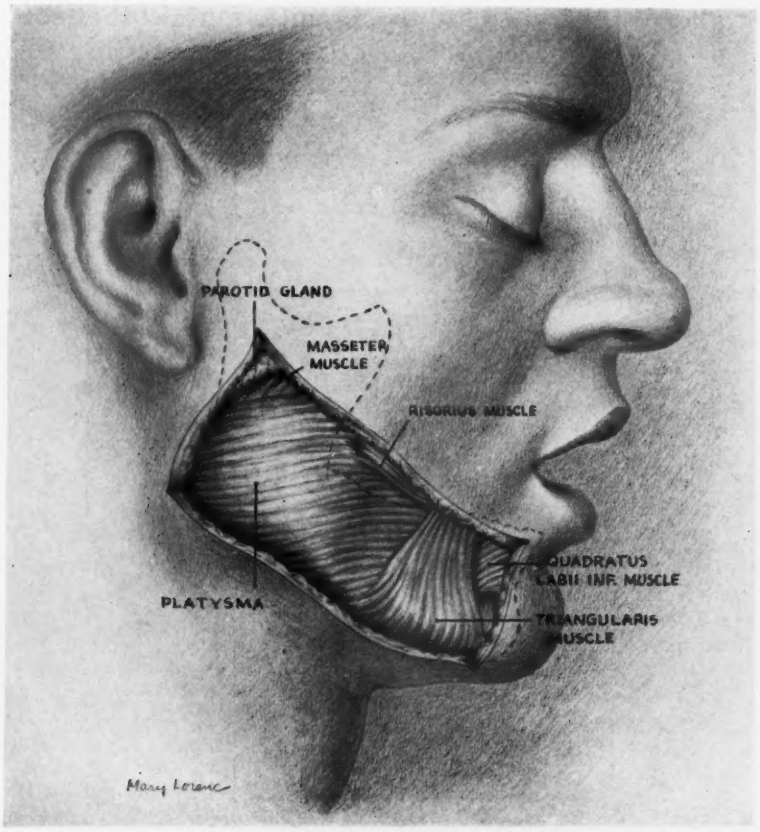


Fig. 3. Underlying musculature after removal of skin surface.

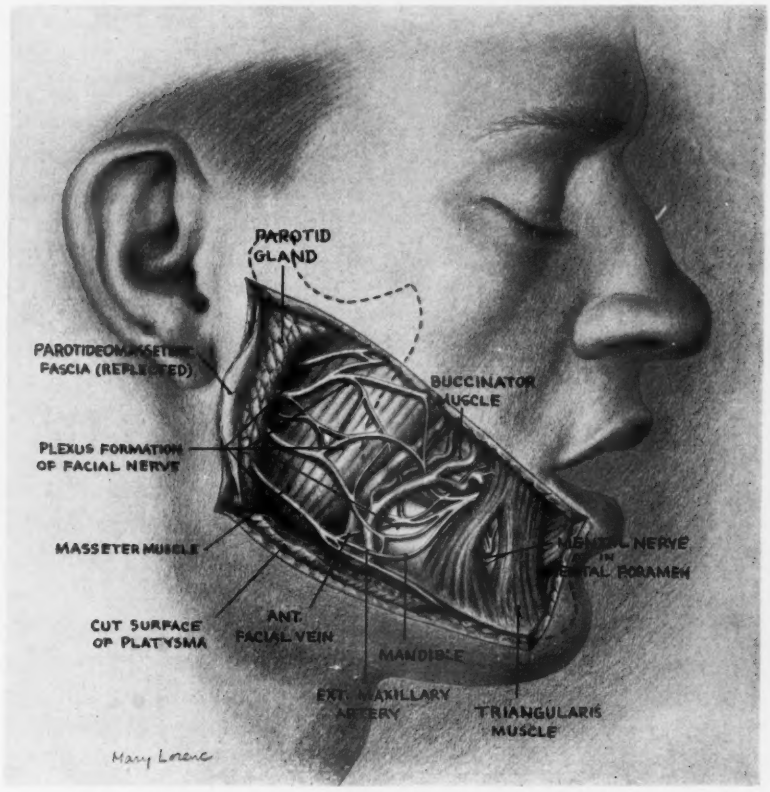


Fig. 4. Dissection following removal of the platysma and risorius muscles.

competent appreciation of the musculature involved, for it is on this basis the respective displacements take place. With the

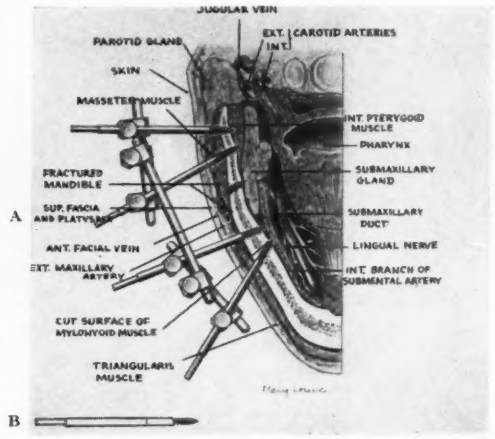


FIG. 5. A, horizontal section through the mandible at the level of the insertion of the pins; B, Winter pin with circumscribed marking.

application of external appliances to the features of the face the underlying anatomical landmarks must be reviewed so as to realize the structures so associated.

The anatomical structures which must be avoided are (1) *The external maxillary artery:* This is avoided by palpating for the notch along the inferior border of the mandible and making the point of insertion for the pins at least one half inch away. (2) *Inferior alveolar canal and its containing structures:* By keeping the insertion of the pins approximately one-quarter inch above the inferior border of the mandible it will be sufficient distance away to avoid penetration of the canal. This decision is dependent upon the radiographic location of the canal. (Figs. 2 to 4.) (3) *Lingual nerve and artery:* These can be avoided by not inserting the pins beyond the cortex of the lingual surface to enter deeply into the tissues of the floor of the mouth and so engage these vessels. (4) *Mental foramen and its emerging structures:* The land marks of the mental foramen can be determined by a line passing through the supra-orbital notch and the infra-orbital notch. These, in conjunction with the mental foramen, are in the same vertical plane. The mental foramen can also be located beneath and between the lower bicuspids.

Muscles	Origin	Insertion	Action
Elevators			
Masseter.....	Zygomatic	Angle and ramus of jaw	Muscle of mastication, molar teeth
Temporal....	Temporal fossa and fascia	Coronoid process of mandible	Elevator
Pterygoid (internal).	Pterygoid fossa of sphenoid	Inner surface of angle of the mandible	Elevates and draws mandible forward
Depressors			
Digastric Anterior belly	Inner surface of mandible	Hyoid bone	Elevates hyoid and tongue
Posterior belly.	Digastric groove of the mastoid	Hyoid bone	Elevates hyoid and tongue
Geniohyoid...	Inferior genial tubercle of mandible	Body of hyoid	Elevates and advances hyoid
Mylohyoid...	Mylohyoid ridge of mandible	Body of hyoid	Elevates and advances hyoid; forms floor of mouth
Platysma.....	Clavicle, acromion, and fascia	Mandible, angle of mouth, etc.	Wrinkles skin and depresses mouth
Rotator			
Pterygoid external.	External pterygoid plate of sphenoid 2. Great wing of the sphenoid	Neck of condyle	Draws mandible forward

A further review of the surgical anatomy would necessitate considering what structures are passed through in the application of the pins. Starting in the area at the angle of the mandible there are: (1) Skin, (2) fascia, (3) facial nerve fibers, (4) parotid gland, (5) platysma and masseter muscle, (6) mandible, and (7) internal pterygoid muscle toward the angle. Anteriorly there are the mylohyoid, geniohyoid and genioglossus muscles, all lingual to the mandible. (Fig. 5.)

ANESTHESIA

For anesthetization in this series of cases one of two methods have been employed. Those patients in whom there was considerable muscular displacement, general anesthesia by the endotracheal route was employed. This allowed for complete muscular relaxation to afford easy manipulation and reduction of the fractured parts.

The other method of choice was that of local anesthesia. This was administered

by one of two methods: extra-oral mandibular nerve block—the Labat technic—was employed in those instances in which there was edema or infection about the site of fracture, as follows:

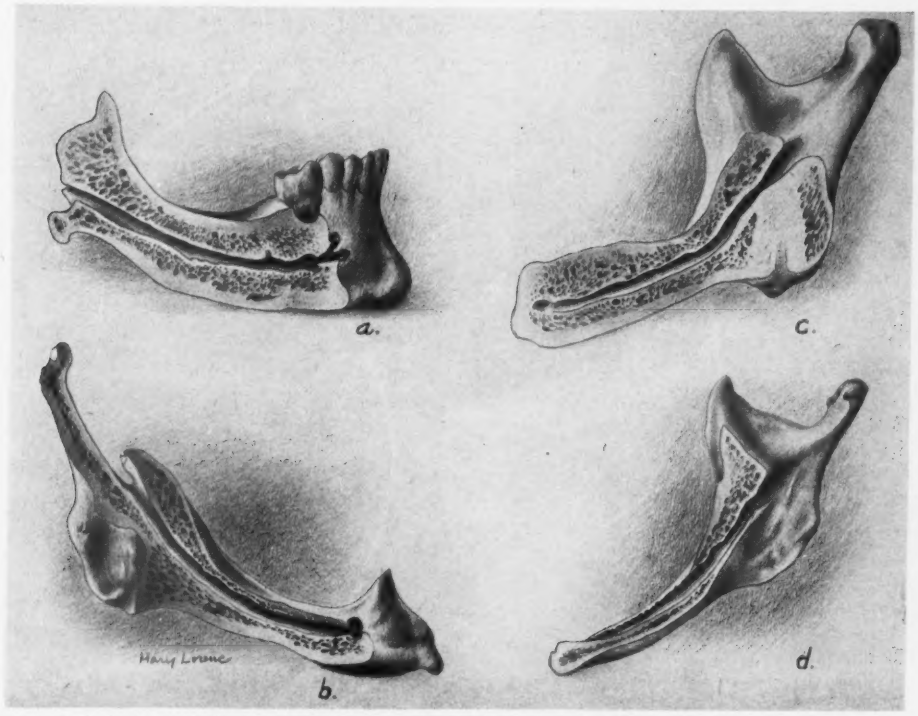


FIG. 6. Relation of the mandibular canal to the body of the mandible according to the degree of absorption of the alveolar process; *a* and *b*, lateral view; *c* and *d*, medial view.

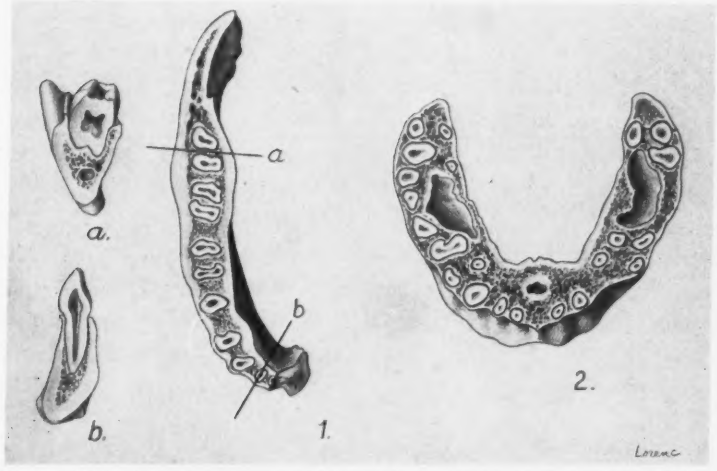


FIG. 7. Relation of the roots of the teeth to the body of the mandible. Lateral incisor (*b*) compared to last molar (*a*). No. 2 is the maxilla.

With the patient's mouth open, the sigmoid notch was palpated and the index finger of the left hand placed at the inferior border of the notch. The area had previously been cleansed, dried and fixed with tincture of iodine and alcohol. A Labat needle (3 inches long) was inserted at right angles above the index finger and directed inward until contact with the external pterygoid plate was made. The needle was withdrawn a few mm. and the direction changed to pass posteriorly and superiorly in the direction of the foramen ovale. At

the point of contact with the third division of the trigeminal nerve the patient will experience paresthesias of the terminal

Fig. 8. Marking the site of fracture and points for insertion of the pins is best accomplished with gentian violet. On colored individuals the markings are made with silver nitrate followed by sterilization of the skin surface with tincture of iodine which produces white markings.

endings of the nerve. The syringe was then attached to the needle and locked. When the aspiration test was negative 3 to 5 cc. of solution (novocaine 2 per cent, pontocaine 0.15 per cent, cobefrin 1:10,000) was injected.

The alternative method of local anesthesia was the block injection for the inferior alveolar nerve supplemented by an infiltration of the skin surface extra-orally and intra-oral infiltration for the buccinator nerve.

OPERATIVE TECHNIC

The area of the face, if male is thoroughly shaved and cleansed with tincture of green soap. The site and directions of the fracture are transposed to the external surface of the skin by indelible pencil or gentian violet markings. The inferior border of the mandible is palpated and just above it, about one half inch on either side of the fracture line, marks are made for the points of insertion of the pins. (Fig. 8.) Care should be exercised to avoid the external maxillary artery, inferior alveolar canal and mental foramen.

The area of operation is painted with tincture of merthiolate. The body and face are draped, leaving exposed only the field of operation. With a Winter pin secured in a hand drill the skin is punctured with a straight jab until contact with the bone is reached. It is not advisable to turn the point through the tissue since the muscle and fascia would become entangled in the threads of the pin and make entrance and fixation in the bone difficult. With proper support to the fractured fragment a slow hand drilling process is performed. The pins are inserted at approximately 70 degrees to each other. This affords a greater contact with the cortical layers of the mandible and so insures firmer fixation of the pins. Once entrance into the bone is made, it is possible digitally to feel the grip that the pin is making in the bony substance. The rotation is continued until the $\frac{3}{8}$ inch marking on the pin has been reached and then, if further rotation is believed necessary it can be continued. This process is repeated with the second pin. Single pin clamps are then applied to each pin, at an equal distance from the skin surface, usually about $\frac{1}{2}$ inch. A rod is fastened through the respective openings in each clamp. In the middle of the rod a double clamp should be applied.

The bolts of each clamp are then tightened to insure that the unit is secure. This constitutes one Frac-sure unit. This procedure is duplicated with the third and fourth pins on the opposite side of the fracture and the second Frac-sure unit completed. With the occlusion of the teeth and the palpation of the inferior border as a guide, reduction of the displaced fracture is accomplished. While this is securely held in position the fixation rod is passed through the respective openings of the double clamps, the bolts of the clamps

Case	Type of Fracture	Location	Duration	Complications
W. S. (2)	Compound	Angle and mental foramen	4 weeks	None
W. F. (2)	Compound[1]	Angle and mental foramen	5 weeks	Abscess
L. M. (2)	Compound[2]	Angle and mental foramen	5 weeks	Osteomyelitis
T. D. (2)	Compound[3]	Angle and mental foramen	4 weeks	None
W. J. (2)	Compound	Angle and mental foramen	5 weeks	None
G. M. (2)	Compound	Angle and mental foramen	6 weeks	None
L. M. (2)	Compound	Angle and mental foramen	Still in position	
R. M. (2)	Compound	Angle and mental foramen	6 weeks	None
I. M. (2)	Compound[4]	Angle and mental foramen	5 weeks	None
C. P. (2)	Compound	Angle and mental foramen	5 weeks	None
J. B. (2)	Compound	Angle and mental foramen	5 weeks	None
F. K. (2)	Compound[5]	Angle and third molar	5 weeks	None
W. R. (2)	Compound	Angle and third molar	5 weeks	None
W. W. (2)	Compound	Right and left third molar	4 weeks	None
F. M.	Compound	Angle	5 weeks	None
W. S.	Compound	Angle	4 weeks	None
H. M.	Compound[6]	Angle, zygoma, maxilla	Still in position	
O. S.	Compound	Angle	4 weeks	None
O. H.	Compound[4]	Angle	Still in position	
M. Y.	Compound	Third molar	4 weeks	None
J. M.	Compound	Third molar	4 weeks	None
W. P.	Compound	Third molar	4 weeks	None
G. M.	Compound	Second molar	5 weeks	None
H. B.	Compound	Second molar	5 weeks	None
R. B.	Compound	Second molar	4 weeks	None
S. E.	Compound[7]	First molar	5 weeks	Osteomyelitis
W. B.	Compound[8]	Mental foramen	6 weeks	Abscess
P. L.	Simple	Mental foramen	4 weeks	None
F. T.	Compound[9]	Mental foramen	4 weeks	None
W. B.	Compound	Mental foramen	4 weeks	None
F. S.	Compound	Mental foramen	4 weeks	None
W. J.	Compound[10]	Symphysis	6 weeks	Abscess
R. J.	Compound	Symphysis	4 weeks	None
B. S.	Compound	Symphysis	4 weeks	None
W. M.	Compound	Symphysis	5 weeks	None
O. L.	Compound	Symphysis	Still in position	

tightened and immobilization of the fracture attained. If, on radiographic examination, it is found the reduction has been incomplete, the bolts of each double clamp are loosened and further reduction attained. The bolts are then tightened. If the articulation of the teeth is found to be faulty, due to the extent of the displacement, it has been found efficacious to resort immediately to the use of arch wires, in conjunction with rubber traction to bring about the desired occlusion. This should be done immediately for it has been found that patients are apt to rebel against the intermaxillary fixation after once experiencing the freedom of motion. This extreme displacement which is found difficult to reduce is usually encountered in cases in which the fracture is of a week or more duration.

INFECTIONS

Throughout the entire series of cases no instance has been encountered in which an infection has been produced by the pins *per se*. In the application of skeletal fixation a phenomenon known as pin seepage occurs. It has been found that there is an

[1] Abscess formation with no sequestration.

[2] Osteomyelitis prior to insertion of pins. This necessitated their insertion at considerable distance from the site of fracture to insure no necrosis of the area and subsequent loosening of the pins.

[3] A combination circumferential wiring was performed for the fracture of the body of the mandible. The extreme displacement of the posterior fragment was taken care of by the application of Roger Anderson skeletal fixation. It would have been impossible to have reduced the right fracture completely by means of the circumferential wiring and for this reason the combination of the two was employed.

[4] Under treatment.

[5] The bilateral fracture in this case involved the refracture of a fracture ten months previous on the left side. The outcome of this case resulted in a fibrous union on the left side. It was impossible to say whether patient ever had complete bony union following previous fracture.

[6] Following the application of skeletal fixation this patient left the hospital at his own risk, and it has not been possible to get a report on his subsequent progress. (Fig. 9.)

[7] An osteomyelitis developed in this case but it did not start at the site of pin insertion. The necrosis that took place extended from the line of fracture through the second molar to encompass the anterior pins. This produced a loosening and necessitated their removal.

[8] This patient was admitted with a fracture of four weeks' duration with external incision for drainage.

[9] The threaded pin had been machined from a point ¼ inch above the threads to the end to decrease its diameter. This metal has been replaced by fusing one of the acrylics to the pin producing an insulation. The purpose of this was to provide an insulation between the pin and the pin clamp. The observations in this case have been similar to others in regard to pin seepage.

[10] This case showed marked displacement and resulted in abscess formation which required external incision for drainage and extraction of tooth in line of fracture.

exudate of serous fluid from the point of penetration of the skin. This, in our observation, is the result of the constant movement of the features and underlying musculature of the face with the resultant tissue exudate. This tissue exudate forms small crust formations and can be readily cleansed with cotton applicators. This has not been found to interfere with the process of healing and callous formation nor is it to be confused with an infectious process such as abscess formation. In our experience the two have not been found to be inter-related whatsoever.

The cases of infection that have been encountered have, in all instances, been in fractures of ten or more days' duration before presentation and fixation, and in which the abscess formation had already presented the characteristic clinical symptoms. The only precautionary measure that was employed in these cases was to insert the pins at a greater distance from the site of fracture than the usual ½ inch, so as to avoid the possibility of any necrosis extending into the area of pin fixation. All of these cases produced callous formation in from four to six weeks with the clearing of the infection.

FIG. 9. Case H. M. with horizontal fracture of the maxilla, depressed fracture of the zygoma and fracture through the angle of the mandible with elevation of the posterior fragment. The zygomatic fracture reduced; the maxilla fracture reduced and immobilized with tray and arms attached to plastic head cap; and Roger Anderson appliance used for reduction of the posterior fragment.

Removal of the appliance is a simple procedure and consists of a complete reversal of the technic of insertion. The double clamps are loosened and the fixation rod removed. (Figs. 10 to 19.) The procedure is repeated with the respective pin clamps and the removal of the rods of the Frac-sure unit. The pins are then removed with a counterclockwise rotation. The whole procedure is performed without anesthesia. The area is then cleansed with tincture of green soap, shaved if necessary, washed with alcohol, and collodion is applied to the pin openings to aid in clot formation.

REMARKS

The advantages of skeletal fixation seem to be many and the multiplicity of instances in which it can be employed urges the author to advocate its use. First, there are the problems of military warfare and second, there is the application of the

Roger Anderson appliance from the viewpoint of its applicability to the fracture itself.

hospitals. Success in the treatment of soft tissue injuries is not only dependent upon the skill of the plastic surgeon and the

Fig. 10.

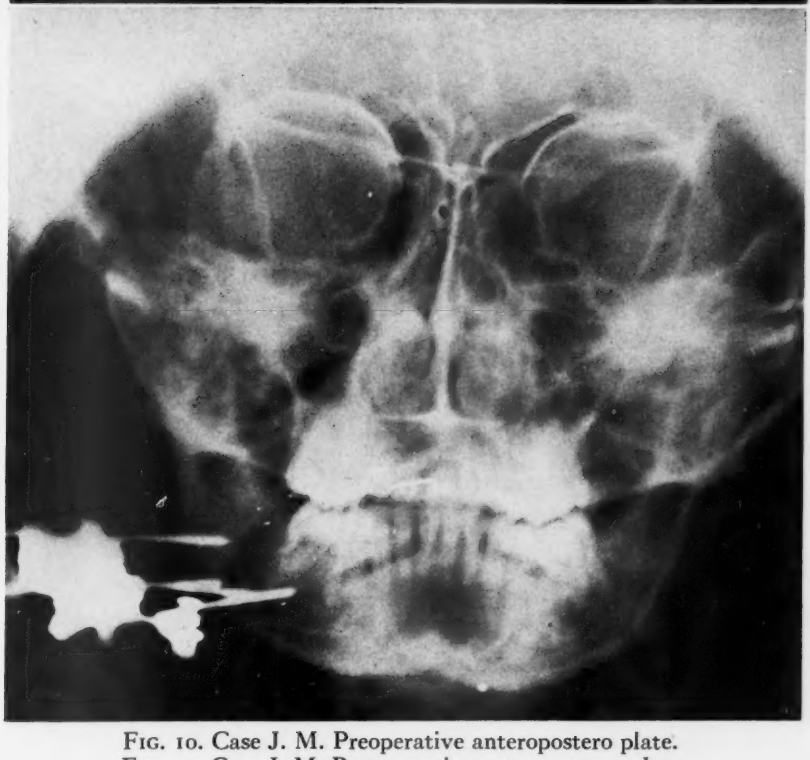


Fig. 11.

Fig. 10. Case J. M. Preoperative anteropostero plate.
Fig. 11. Case J. M. Postoperative anteropostero plate.

Wounds sustained in combat areas present the problem of emergency first aid measures subsequent to the transporation of the wounded to base or reconstruction

"take of the graft," but it is also contingent on the situation which would allow the plastic surgeon to have an ideal area upon which to operate. Not only is radical

débridement a principle which should be avoided in the soft tissues of the face, but maintenance of space, the loss of which has been produced by shrapnel injuries, must be considered. In this fashion bone grafts or the application of vitallium and tantalum plates can be subsequently performed, but these can have the maximum possibilities of success only when the space has been kept and no collapse of tissues allowed.

FIG. 12. Case J. M. Profile of patient with appliance attached.

FIG. 13. Case J. M. Photograph of patient with mouth open.

A second feature, characteristic of military surgery, is the necessity of rapid evacuation and transportation of the injured to sheltered areas in the rear lines or overseas. This necessitates some form of fixation of the fracture that will allow comfort and ease for the patient with a minimum of nursing care from an administrative viewpoint, and fixation of the fragments with adequate immobilization from the surgical viewpoint.

Skeletal fixation, as exemplified by the Roger Anderson appliance presents a device with a simplicity of application that will fulfill the demands of military warfare. The ease and rapidity of application with a minimum of equipment can allow for immediate treatment of the fractures in any field hospital or first aid station. The absence of intermaxillary fixation avoids the complication of nausea and nursing problems during the transporation of the patient. The feeding problem does not exist with this form of fixation and here again there is minimization of the nursing problem. However, in the problem of space retainer, from the surgical viewpoint, the application of the Roger Anderson skeletal fixation appliance has its greatest value. This, combined with the ease of manipulation, makes it highly indicative from the discussed combat aspect.

In a consideration of civilian traumatic injuries, the problems of transportation, and nausea are not as prevalent. From the viewpoint of the type of fracture for which skeletal fixation is indicated, there is the problem of reduction of the posterior fragment. In reviewing the other methods that have been successfully employed there is the plaster head cap with wire traction

FIG. 14.

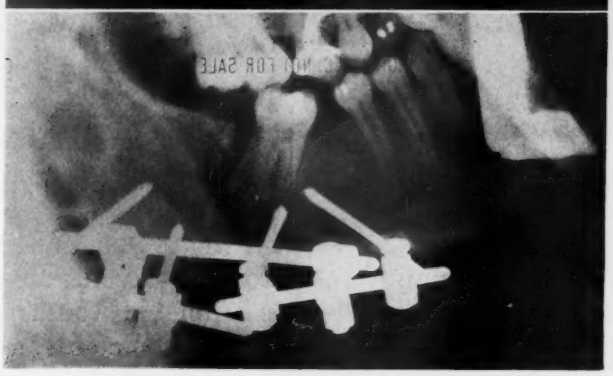


FIG. 15.

FIG. 14. Case J. M. Lateral plate revealing elevation of posterior fragment.

FIG. 15. Case J. M. Postoperative lateral plate showing reduction of fracture with Roger Anderson appliance. Because of the proximity of the inferior alveolar canal to the inferior border, the anterior pins were applied above the canal.

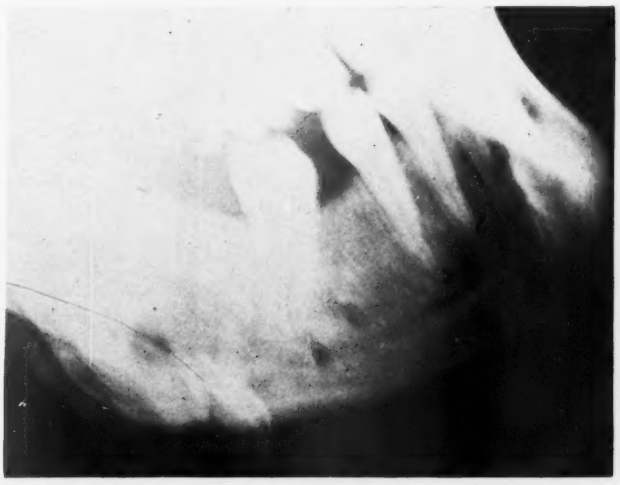


FIG. 16. Case J. M. Lateral *x*-ray plate showing bony union with perfect apposition of posterior and anterior fragments.

for the reduction of the posterior fragment, open reduction with vitallium plate, or interosseous wiring. All these methods

Fig. 17. Case J. M. Photograph showing occlusion of teeth.

necessitate open operations with the exposure of the angle of the mandible and are extensive operative measures in comparison with skeletal fixation. In regard to fractures of the edentulous mandible, in which there is much displacement of the fragments or in which the fracture is beyond the molars, the efficiency of circumferential wiring is considerably curtailed and does not compare in efficacy with that of the Roger Anderson appliance.

Fractures of the symphysis in which the displacement produces a comminution of the fragments as a result of the powerful tendency and pull of the mylohyoids are found to be best treated with the application of an arch wire in conjunction with a Roger Anderson appliance. In this fashion the patient can still retain adequate motion and function of the mandible and yet maintain complete immobilization.

With respect to the teeth in line of fracture, the use of skeletal fixation presents a distinct advantage over other methods of fixation. To begin with, the necessity of retaining any particular tooth as a means of securing an arch no longer exists. The necessity of retaining a third molar in line of fracture in order to occlude with the upper teeth to depress the posterior fragment similarly affords no problem in the use of skeletal fixation. In an effort to avoid abscess formation, any questionable tooth may readily be removed at the outset of the case or at any time during the length of treatment since complete access is always available into the mouth.

Fig. 18. Case J. M. Profile view one week following removal of appliance.

Fig. 19. Case J. M. Front view of completed case.

Depressed fractures of the maxilla, of either the horizontal or vertical type, afford a further problem when complicated with fracture of the mandible. The immobilization cannot consist of intermaxil-

lary fixation, since the maxilla is no longer a fixed point. Any movement or attempted opening of the mouth would only further displace the maxillary fracture. These patients are best treated individually. For the fracture of the mandible, the ideal method would be skeletal fixation since this would in no manner interfere with whatever prescribed treatment is applied to the maxillary problem.

A distinct contraindication for the application of Roger Anderson skeletal fixation is in the treatment of fractures of the mandible in children. Because of the presence of tooth buds beneath the deciduous teeth, the insertion of pins could produce a distinct injury to the permanent teeth.

CONCLUSIONS

The advantages and indications for application of the Roger Anderson skeletal fixation are: (1) Ease of application; (2) maintenance of immobilization and further reduction when needed; (3) complete function of the mandible; (4) minimum of nursing; (5) no feeding problem; (6) simple technic for reduction of posterior fragment; (7) no concern in regard to nausea and vomiting; (8) In macerating injuries of the face in which, segments of the bone have been lost, the appliance is applicable for the maintenance of space. (9) Extraction of teeth whenever removal of teeth is indicated in view of the loss of investing bone substance which would result in possible non-union or abscess formation. With intra-oral fixation such teeth would have to be retained to serve the purpose of holding the posterior fragment down or as an anchorage for intermaxillary fixation. (10) Ability to treat fractured mandibles when there is the added complication of a fractured maxilla.

In the selection of an appliance for the treatment of fractures of the mandible, definite evaluations must be made: First, Insofar as the reduction of the posterior fragment is concerned, skeletal fixation should be used in preference to any open method of reduction. Second, in edentulous mouths, in which circumferential wiring cannot be employed, i.e., no intra-oral appliance can reach the posterior portion, skeletal fixation would be the method of choice. Third, in fractures of the body of the mandible, in which intra-oral fixation could be successfully employed, it is a matter of personal equation as to whether the patient desires to use his jaws during the process of healing or whether, because of aesthetic appearance, he would prefer immobilization and fixation of the jaws, and subsist on a liquid diet.

When skeletal fixation, by means of the Roger Anderson appliance fails to restore the original occlusion or articularion, intermaxillary force should be applied immediately to reduce the musculature displacement. This may have to be kept in position for three or four days. Failure to do this at the time, permitting freedom of the jaws for even a few days, will find the patient unco-operative.

INGUINOFEMORAL ANATOMY*

ASPECTS SIGNIFICANT FOR INGUINAL HERNIORRHAPHY

EDWARD J. KOMORA, M.D.
Surgical Service, Veterans Administration
BATAVIA, NEW YORK

THE phenomenon of inguinal hernia exhibits a wide diversity of form. It is signalized in surgical literature by the recording of a corresponding multiplicity of plastic therapeutic procedures. Inguinal herniorrhaphy appears almost as a prototype of surgery's attempt to minimize and eliminate the vulnerability of man's material structure. It seems to be literally a microcosm of surgery in which the anatomy of the operative region seems particularly intriguing and is at once both seductive and exasperating, ever tempting and teasing the ingenuity of the operator.

In the main, most of the modifications and variants of the original Bassini and Halsted operations excogitated either under the stress of the actual surgical moment or in the composure of dissecting room study have been of solid value for any given hernia problem. Collectively, they provide the eclectic surgeon with a choice of procedures supplying the technical solution of the very great majority of reparative dilemmas. Zimmerman[1] in his review of the recent trends in the treatment of inguinal hernia writes that the "Growing emphasis upon the anatomical lesion present in the various types of hernia and an attempt to match the surgical procedure to the specific lesion point the way to better results in the surgery of inguinal hernia."

Certain details of inguinofemoral anatomy are submitted here with a view toward refreshing anatomic insight of the region and an attempt made to construe some practical utility therefrom. Though no illustrative case file is available at this time to accompany the data, these seem arresting enough to merit presentation. The convenience of presenting them within a surgical frame of reference will be evident. Accordingly some few gleanings from the later literature pertinent to an analysis of the findings described here will be given.

Tanner's[2] modification of the Bassini operation may be cited first because it appears to illustrate a device of tissue maneuver applicable to these findings and also because it easily orients the discussion in its allusion to technical points still moot in the general problem of herniorrhaphy. According to Tanner, his method is a "sliding of the sheath of the rectus muscle downwards and laterally in such a way that a repair of the posterior wall of the inguinal canal with living and functioning muscle is attained . . . a curved incision is made, through the fused aponeurosis of the internal oblique and transversus, commencing at or slightly below the level of the pubic crest and as far medially as the dissection will allow. This incision passes straight upwards, then curves outwards to end a hand's breadth above the pubis and about two cm. medial to the lateral edge of the rectus abdominis muscle . . . As soon as this incision is made, there is a tendency for the lateral edge of the incision to slide downwards and laterally . . . It will now be observed that the high arching fibres of the internal oblique (conjoint tendon) are flaccid and straight and tend to lie parallel to Poupart's ligament. Even if the lower fibres of the internal oblique were deficient some

* Published with the permission of the Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

muscle fibres will now be found close to Poupart's ligament. Interrupted silk sutures are now placed so as to unite this

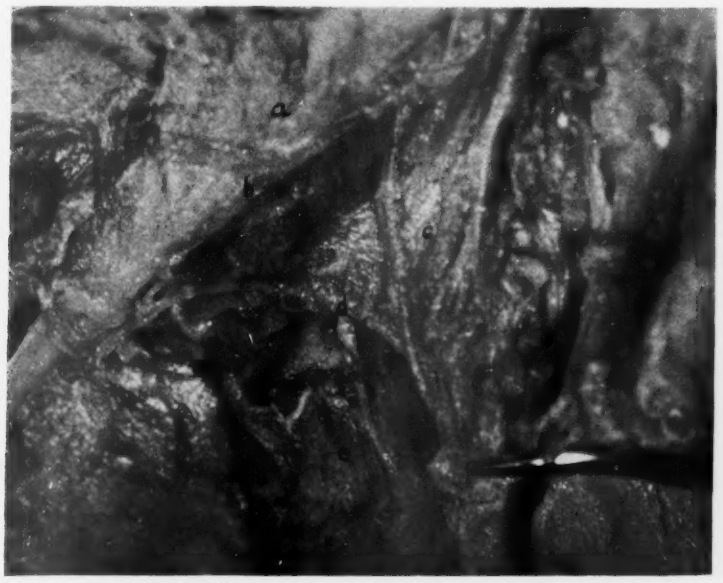


Fig. 1. *a*, external oblique aponeurosis; *b*, Poupart's ligament; *c*, fascia lata; *d*, upper crescentic margin of fossa ovalis; *e*, sheathed femoral vessels.

tissue to the reflected part of Poupart's ligament . . . A fine continuous silk suture is now run between the lateral cut edge in the rectus sheath and the adjacent rectus and pyramidalis muscle . . . "

It is seen that in Tanner's method the subcutaneous mixed elements of the body wall are deployed in a way which exacts the maximum efficiency physiologically characteristic of each element within the conditions of the plastic re-arrangement. This stands as a favorable concrete commentary on the debatable point of suturing fascial tissue to muscle. Both the rectus muscle, uncovered and sutured to its own fascial sheath, as well as the dislodged muscular portions of the falx have had their effective contractile function preserved to a great degree. Avoidance of compromise of this intrinsic dynamic faculty of the body wall structure herein involved has always loomed large in the consideration of every surgeon. Grant[3] interestingly re-states this mechanism when he describes the inguinal canal as an "inguinal arcade," likening it to an arcade of three arches traversed by the spermatic cord: "The contraction of the external oblique approximates the anterior wall to the posterior wall and the contraction of the arched fleshy fibres of (the inguinal portion of) the internal oblique and transversus causes them to become straighter and taut, in consequence of which the roof of the canal or arcade is lowered and the passage constricted. The action is that of a demi sphincter."

Tanner's slide operation encumbers this mechanism to a minimal degree. Neuhof,[4] and earlier, Anson and McVay[5] have introduced the use of Cooper's ligament as a substitute for the Poupart anchorage because they question the latter's adequacy and suitability. Neuhof states that "whether the conjoined tendon or rectus sheath or aponeurosis of the external oblique are joined to the reflected surface of Poupart's ligament, . . . the objective remains a protective shelf and not a direct support of the undefended space and that the utilization of Cooper's ligament instead offers direct support to the mesial portion of the undefended space in the form of a sling like buttress, and also reduces to some degree the size of that space." Anson

and McVay criticize the use of Poupart's because it "is not the insertion of the transversalis fascia, the transversus abdominis aponeurosis, or the internal oblique aponeurosis; its relationship to these structures is simply one of contiguity. From an anatomical standpoint this is reason enough for endeavoring to find some other structure for anchorage." In contrast to the innovation rationalized by these authors Tanner implicitly reaffirms the architectural convenience and structural reliability of the inguinal ligament so invariably assumed by the earlier writers.

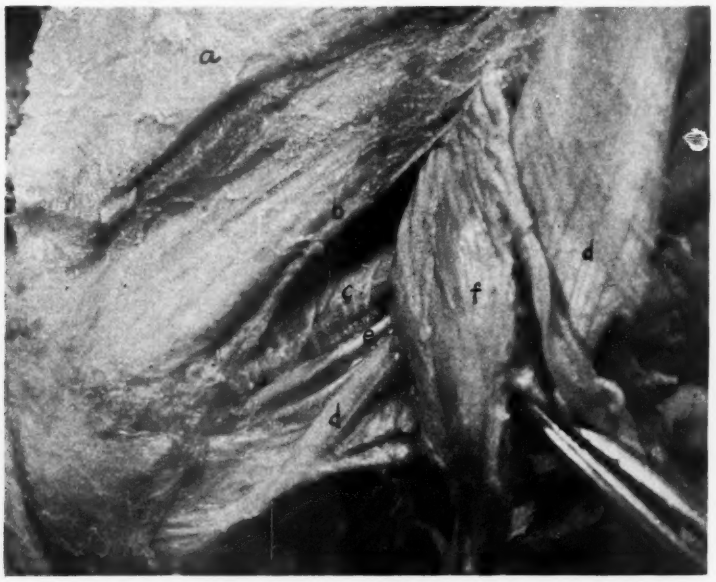


FIG. 2. *a*, superomedial leaf of external oblique aponeurosis; *b*, edge of conjoined tendon; *c*, transversalis fascia; *d*, inferolateral leaf of external oblique aponeurosis; *e*, Poupart's ligament; *f*, spermatic cord.

Reflection on the characteristic configuration of the body walls in the inguinal region may be helpful at this point. The general celomic space is made up of three distinct portions: that of the true abdomen, that of the false or greater pelvis and that of the lesser or true pelvis. That portion, the conformation of which is significant in the consideration of hernia is that of the greater pelvis—that area enclosed by the iliac fossa and the lowermost portions of the musculature of the anterior body wall. Observing the body in the upright or hernia producing attitude, the space is seen to have the appearance of an inverted gable or trough with the sides unequally and irregularly warped and slantingly placed. Because the anterior superior spine and the pubic tubercle occupy virtually the same frontal plane, the lowermost portion of the anterior body wall, terminating in the inguinal ligament, forms the relatively flat anterior wall of the trough. This anterior wall, endowed with the physiological action alluded to in Grant's description, effects its retaining function dynamically. The surface bounded above by the iliac fossa traverses a warped spheroid plane and constitutes the posterior wall. The crest of the inverted gable or rather the angle of the trough is formed by the junction of the inguinal ligament and its lacunar reflection with the structures lining the false pelvis, namely, the iliopsoas muscle, and the sheathed femoral vessels. The notion of an inguinal trough is incomplete unless it comprehends two other elements —the iliopsoas fascia and the fascia lata. This is true because although the inguinal ligament ostensibly constitutes the essen-

tial feature of the angle of the trough, both the fascia lata and the iliopsoas fascia contribute substantially to the stability of its architecture, making their continuity with the external oblique aponeurosis, i.e., its caudal limit, the inguinal ligament, functional as well as positional. This functional continuity seems implicit in Gray's[6] description of the attachments of the inguinal ligament: "the superficial portion of the fascia lata . . . is attached . . . to the whole length of the inguinal ligament and to the pectineal line in conjunction with the lacunar ligament," and "the iliopsoas fascia lateral to the femoral vessels is intimately connected to the posterior margin of the inguinal ligament."

Fig. 3. *a*, superomedial leaf of external oblique aponeurosis; *b*, edge of conjoined tendon; *c*, spermatic cord; *d*, Poupart's ligament; *e*, fascia lata; *f*, edges of incised fascia lata.

The brief anatomical investigation submitted here is offered in support of this implication. It was prompted in order to clarify and establish anatomical validity for surgical exploitation of a phenomenon observed by the writer in the course of a Wangensteen repair of a recurrent hernia. At that time it was noted that coincidentally with the loosening and mobilization of the fascial flap in the thigh the inguinal ligaments relaxed and moved up along the abdominal wall. It was apparent that the liberation of the fascial structures in the thigh had reduced the taut fixity of Poupart's ligament and, while leaving its orientation to the other musculoaponeurotic structures intact, had permitted it to shift—almost in toto—closer to these structures. This movement as might readily be understood, very appreciably narrowed the gap, the covering of which, is the basic desideratum of approximating the parts of the "inguinal arcade" in any dynamic or static succession or combination whatsoever, to Poupart's ligament. What had been observed was an uncalculated process analagous to Tanner's slide maneuver but with the slide initiated from below and mediated through the manipulation of other tissues.

The subsequent anatomical studies consisted in full visualization of the phenomenon on ten dissected inguinofemoral areas, four on embalmed and six on fresh unembalmed material. It was found that in each instance a horizontal incision of the thigh fascia—specifically the fascia lata—beginning at the midpoint on the periphery of the crescentic falciform margin of the fossa ovalis and extending outward across the thigh effected a loosening and relaxation

of the inguinal ligament similar to that observed at the operating table and allowed the same upward movement of the ligament ahead of the gliding fascia. Complete cleavage of the fascia lata from the subjacent iliopsoas fascia was readily accomplished, increasing this relaxation, and better still, stripping the iliopsoas fascia from the underlying muscle made the relaxation virtually complete. The upward advance of the ligament now reduced the space between it and the musculotendonous arch above it (internal oblique, conjoined tendon, lowermost portion of the rectus sheath) to a mere crevice.

It had appeared plausible to the writer then, that possibly the purposive device of freeing the fascia in the upper anterior thigh might be extremely useful in the routine repair of ordinary hernia. It would, as stated before, reduce the gap to be bridged in the closure of the defective anterior inguinal wall, thus lessening the tension on the structures used in accomplishing this bridgement, and, would seem to give most effective promise of precluding recurrence. The inguinal ligament having relinquished its position at the angle of the inguinal trough would have become a more accessible ledge to which Grant's inguinal arcade could be moored and its topographical site occupied by the thigh fascia after its glide upward to a higher position on the thigh. The fascia would now be a component of the inguinal trough. Competence of the trough should result since the same adaptibility for security of union exhibited by musculofascial suture in the upper inguinal phase of the usual herniorrhaphy could be relied upon to give solidity to the infraligamentary closure of the trough by suture of the fascial strata to the thigh muscles. But even more important than the effectiveness of musculofascial suture, and, perhaps crucial, would be the tensile power of the thigh fascia itself. This is especially true in the face of Anson and McVay's adverse estimate of the stability of union between the inguinal ligament and the fascia lata. In the dissections described here this stability seemed energetic enough since it was found that with the fingers placed behind the stripped up fascia, sustained advancing ventral pressure forced them not through the fascia or the oblique aponeurosis or through the line of fascial-aponeurotic continuity, but rather guided them up behind the inguinal ligament and into the pelvis where simultaneous visualization of the dissected body cavity disclosed the exploring digits to be entirely retroperitoneal and in direct contact with the intracelomic portion of the iliopsoas fascia. Anson and McVay write that "the inguinal ligament itself is a marginal structure separate from the fascia lata of the thigh" and that "the inguinal ligament, contrary to the usual conception, is loosely held in its convex position by the surrounding fasciae; it is easily shelled out of its fascial bed by the finger or a blunt instrument, to become merely the free margin of the aponeurosis which extends between the anterior superior iliac spine and the pubic tubercle. Its attachment is broadened laterally by fibres of insertion passing into the iliopsoas fascia and medially by the expansion known as the lacunar ligament; between these two points it is relatively pliant. When traction is applied in a cephalad direction, simulating the pull of the muscles which might be sutured to it, it is displaced superiorly far enough to leave the lower inguinal region completely exposed beneath it. In recurrent hernia occasionally the mass seems femoral in position, hernia having elevated the inguinal ligament."

These statements give the present interpretation of inguinofemoral fascial aponeurotic elements a controversial profile and seemingly dislimn the picture of a design of practical usage envisioned for them as projected herein. Yet neither do they discount the fact of the inguinal ligament's potential mobility and in this respect it may be that the significance of the fascia as here contemplated with regard to its management in herniorrhaphy is gratui-

tous. Pack and Reker's[7] description of their surgical groin dissections for malignant tissue tumors of the region is pertinent here since it may lend some support to the *a priori* validity of the maneuveribility of the inguinal ligament. They write: "The dissection proceeds from above downward, removing all the fascia from the muscles of the anterior thigh (sartorius, iliacus, pectineus, adductor brevis, rectus femoris)." A step is then taken "giving exposure of the inguinal canal which is incised from the external ring to the point where the round ligament or spermatic cord dips downward into the pelvic cavity. The canal is further exposed laterally by incising the external oblique fascia and the transversalis muscles down to the properitoneal fat . . . The external oblique fascia and the inguinal ligament are then severed about two inches from the attachment to the pubic spine . . . The entire groin dissection is performed with the scalpel and at the completion of the operation practically no fat or fascia should be left in the operative field except the normal structures necessary to reconstruct the inguinal ligament and canal. . . . The inguinal canal is then closed in the manner customary for herniorrhaphy. The inguinal ligament is reconstructed and sutured around the femoral vessels without occluding them." In this procedure it is seen that the inguinal ligament is dislodged and is completely without benefit of the thigh fascia. Yet the reconstruction of the inguinal trough has been effected. Presumably, the movement of the inguinal ligament as described herein and shown in Figure 3 has occurred. It appears evident that if the inguinal trough deprived of all fascial elements is competent, then a fortiori following the tissue maneuver here pictured, that same degree of competence and serviceability should remain.

It would seem then, that freeing the fascia in the upper anterior thigh as here described, might be extremely desirable and useful in the routine repair of ordinary inguinal hernia, and what is most important very considerably preclude recurrence. Regardless of whether the primacy of a dynamic or static function of the available structures of the abdominal wall is to be invoked in a given repair the execution of such a maneuver could be integrated with those features characterizing established procedures and confer on them a greater efficacy. Robins'[8] union of lower rectus sheath and muscle to the ligamentous tissue on the superior surface of the pubic bone; Jones'[9] distinctive use of the combined transversalis fascia and transversus aponeurosis by conducting it through the internal oblique muscle on its way to attachment to Poupart's; Zieman's[10] less elaborate and adynamic employment of the transversalis fascia; Stein's[11] avoidance of direct muscle suture by developing and mobilizing the internal oblique fascia; each of these mutations and evolutions of the Bassini and Halsted operations would all be used with greater advantage.

The following remarks are offered as an aid in distinguishing and identifying the labeled parts of the photographic figures:

Figure 1 shows the deep surface of the inguino femoral terrain. The skin and superficial adipose tissues and fasciae (marginal elements derived from Colles and Scarpa's layers) have been mostly removed. The apparent and obvious continuity of the external oblique aponeurosis and fascia lata is plainly seen, the linear oblique ridge indicating the site where, with regard to the functional purpose contemplated for these elements, the unitary character of the two structures would be of crucial importance. The upper falciform margin of the fascia lata where it forms the superior crus of the fossa ovalis is easily discerned; the cribriform fascia has been removed and the femoral sheath or envelope enclosing the femoral artery and vein are also indicated.

Figure 2 displays the inguinal half of the field. The aponeurosis of the external oblique has been incised. The resulting

infernolateral leaf has been turned down. A superomedial leaf has been developed and turned up. The spermatic cord severed from its scrotal half is turned aside laterally across the infernolateral aponeurotic leaf. The inguinal canal is accordingly uncovered with the conjoined tendon and lowermost portion of the sheathed rectus, Poupart's ligament, and the "pavement" transversalis fascia readily distinguishable, too. The gap between the arched margin of the musculotendonous-fascial elements of the "inguinal arcade" and the inguinal ligament is evident with the structures as here viewed in their normal position.

In Figure 3 the view is widened to envision again the composite inguinofemoral region. The hemostat grasping Poupart's has easily drawn it up to the edge of the "inguinal arcade," because the thigh fascia has been incised beginning at the periphery of the crescentic falciform margin of the fossa ovalis at a point marking the inferolateral extremity of an oblique axis or diameter of the fossa and from there extending outward across the thigh.

SUMMARY

Aspects of inguinofemoral anatomy are briefly reviewed.

Relevant anatomical studies are described and attention called to details of fascial-aponeurotic function in that region.

Their surgical application in the technic of inguinal herniorrhaphy is suggested.

The anatomical studies from which the accompanying photographic figures are taken were made through the facilities graciously provided by Professor Karl Mason, of the Department of Anatomy, at the Rochester University School of Medicine and Dentistry. Dr. Milton I. Schwalbe, urologist at the Veterans Administration Facility at Batavia, generously prepared and made the photographic reproduction of the dissections.

REFERENCES

1. Zimmerman, Leo M. Recent trends in the treatment of inguinal hernia. *Internat. Abstr. Surg.*, 68: 123–130, 1939.
2. Tanner, Norman C. A slide operation for inguinal and femoral hernia. *Brit. J. Surg.*, 29: 285–289, 1942.
3. Grant, J. C. Boileau. A Method of Anatomy. Pp. 197–198. Baltimore, 1940. The William & Wilkins Company.
4. Neuhof, Harold. An operation for inguinal hernia based upon the utilization of Cooper's ligament. *Surgery*, 128–132, 1942.
5. Anson, Barry J. and McVay, Chester B. A fundamental error in current methods of inguinal herniorrhaphy. *Surg., Gynec. & Obst.*, 74: 746–750, 1942.
6. Gray, Henry. Anatomy of the Human Body. Pp. 470–467. Philadelphia and New York, 1924. Lea & Febiger.
7. Pack, George T. and Rekers, Paul. The management of malignant tumors in the groin. *Am. J. Surg.*, 56: 545–565, 1942.
8. Robins, Charles A. Why inguinal hernia recurrs. *Ann. Surg.*, 114: 118–128, 1941.
9. Jones, Walter Falke. Operation for greater mobilization of the transversalis fascia in the repair of direct inguinal hernia. *Am. J. Surg.*, 50: 27–28, 1940.
10. Zieman, Stephen A. The fallacy of the conjoined tendon, the etiology and repair of inguinal hernia. *Am. J. Surg.*, 50: 17–26, 1940.
11. Stein, Herbert E. Inguinal hernia, a new concept and operation. *Am. J. Surg.*, 56: 480–482, 1942.

OVARIAN CYSTS COMPLICATING PREGNANCY

A. J. CAPONE, M.D.
Junior Visiting Surgeon to the Somerville Hospital
SOMERVILLE, MASSACHUSETTS

PREGNANCY when complicated by the presence of an ovarian tumor may follow an entirely uneventful course, but on the other hand serious conditions may arise that endanger the pregnancy and threaten the life of the patient.

The presence of an ovarian cyst constitutes one of the most menacing complications of pregnancy. Usual accidents to ovarian cysts in the non-pregnant are more apt to occur in pregnancy. Some of the following serious possibilities are to be mentioned. Abortion or premature labor may occur; torsion of the ovarian pedicle may occur giving rise to an acute surgical emergency that may develop during gestation, labor or puerperium. It may constitute a serious obstacle to delivery, necessitating the performance of cesarean section in order to effect delivery or if the obstacle is not recognized, rupture of the uterus may occur. The cystic tumor may rupture during delivery. Gangrene of the tumor has occurred due to the prolonged pressure upon it during labor.

OCCURRENCE AND PATHOLOGY

A review of ovarian cysts complicating pregnancy by Caverly, of New York, and Lynch, of San Francisco, gave the following statistics: The incidence of this complication ranges from 1 to 500 to 1 in 1,500 cases, while the age incidence is between twenty-eight to thirty years. The occurrence between primaparae and multiparae is equally divided. The majority of the cysts were unilateral and 50 per cent of them were dermoids. It was further noted that 25 to 30 per cent of the cysts were located in the true pelvis and of these pelvic tumors 60 per cent were dermoids, which illustrates the fact that the cyst most likely to remain in the pelvis and obstruct labor is the dermoid.

GROWTH

There is a difference of opinion concerning the growth of ovarian cysts during pregnancy. Some state that there does not appear to be any evidence of specially rapid growth. Others are of the opinion that some rapidly increase after conception. Caverly found a gradual enlargement of the cyst in forty-six cases collected from the literature. Such a case of a rapidly growing cyst is reported in this paper. It is of interest because of the large size attained and because the patient was delivered normally of a live, full-term seven pound baby per vaginam. Eight days postpartum a tremendous simple unilocular cyst was removed containing fourteen quarts of fluid.

SYMPTOMS AND COMPLICATIONS

Often the presence of a cyst causes no symptoms whatsoever, or only moderate discomfort attributed to the usual disturbances of pregnancy. Complications are usually due to rupture, suppuration, torsion and hemorrhage into the cyst. The most dreaded complication is rupture of a dermoid cyst with ensuing chemical peritonitis. Such a case is reported in this paper.

CASE REPORTS

The following three cases were personal cases of the author:

CASE 1. Mrs. R. C. F., No. 68667, age twenty-eight, was admitted to Somerville Hospital on December 20, 1941 and discharged March 26, 1942.

This case demonstrates the postpartum complications encountered with a lutein cyst

of left ovary and dermoid cyst of right ovary that ruptured during labor.

This patient was delivered at this hospital on December 20, 1941, by high forceps, following a hard labor of three days. The immediate postpartum course was uneventful until the twelfth day at which time she began to complain of right lower quadrant pain. Within the next two days there developed generalized abdominal pain, hyperpyrexia and abdominal distention. On the fourteenth postpartum day the temperature was 102.6°F., pulse 128, respiration 32, white blood count 34,600 and sedimentation rate 48 mm. in one hour by Westergren method. Abdominal examination revealed a tender mass the size of a large orange in the right lower quadrant. It was believed at this time that the condition was a pelvic abscess and peritonitis and it was therefore decided to operate after the acute symptoms subsided. She was treated expectantly; a 500 cc. citrated blood transfusion was given on the twenty-sixth postpartum day and 500 cc. on the fortieth day. A sulfathiazole level of 6 mg. per 100 cc. continued for twenty-two days. Her condition gradually improved; on the seventy-ninth day the temperature was 98.4°F., white blood count 9000, red blood count 4,250,000, hemoglobin (Sahli) 88 per cent, sedimentation rate 12 mm. in one hour (Westergren method). At this time pelvic examination revealed a non-tender mass the size of an orange at the right vault; the uterus was fixed. Operation was carried out on the eightieth postpartum day.

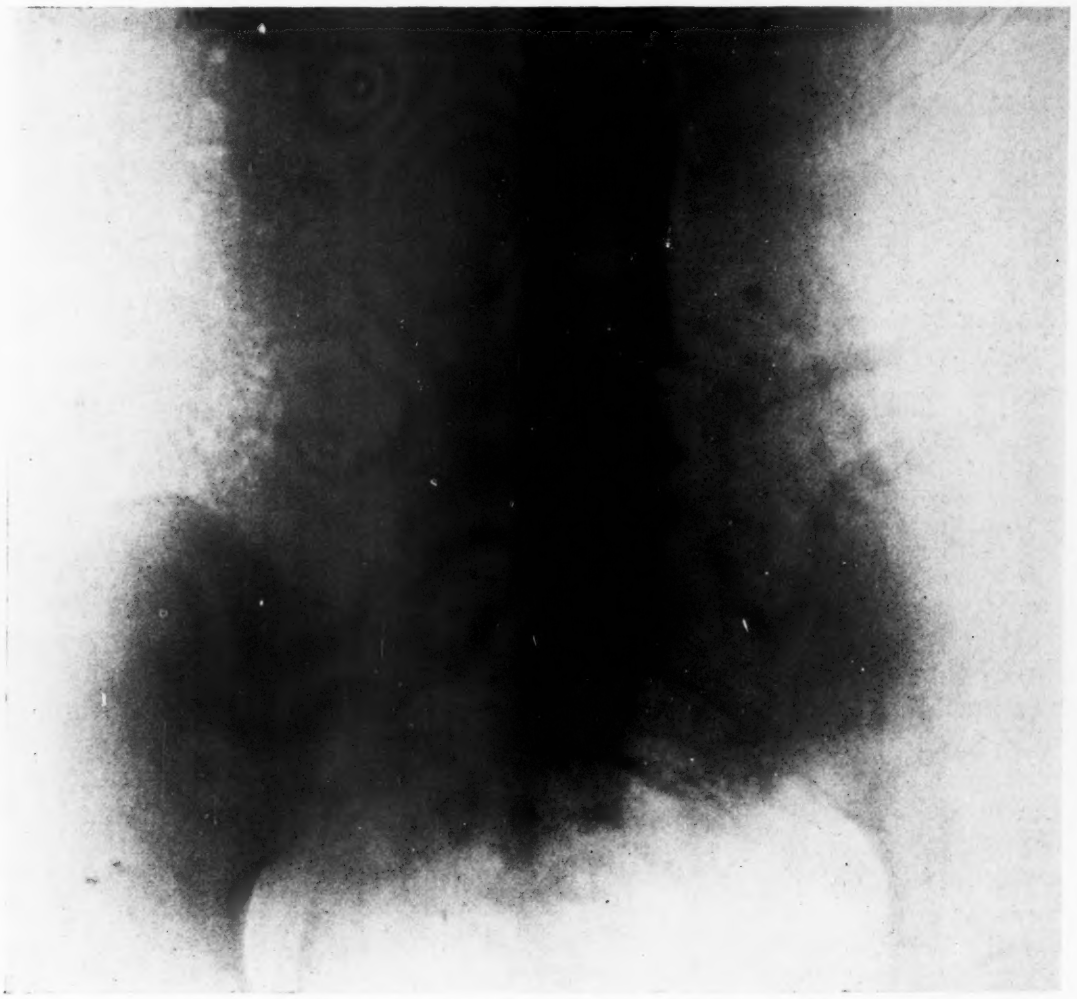


FIG. 1. A, *x*-ray photograph (anteroposterior view) of Case 11 taken at eighth month of pregnancy illustrating the abnormal position of the fetus due to pressure of large ovarian cyst on the uterus.

Operation was performed on March 12, 1942, under gas, oxygen and ether anesthesia. A midline incision from umbilicus to pubis was

made. The omentum was found to be attached to the anterior abdominal wall and pelvic structures; its separation revealed bilateral

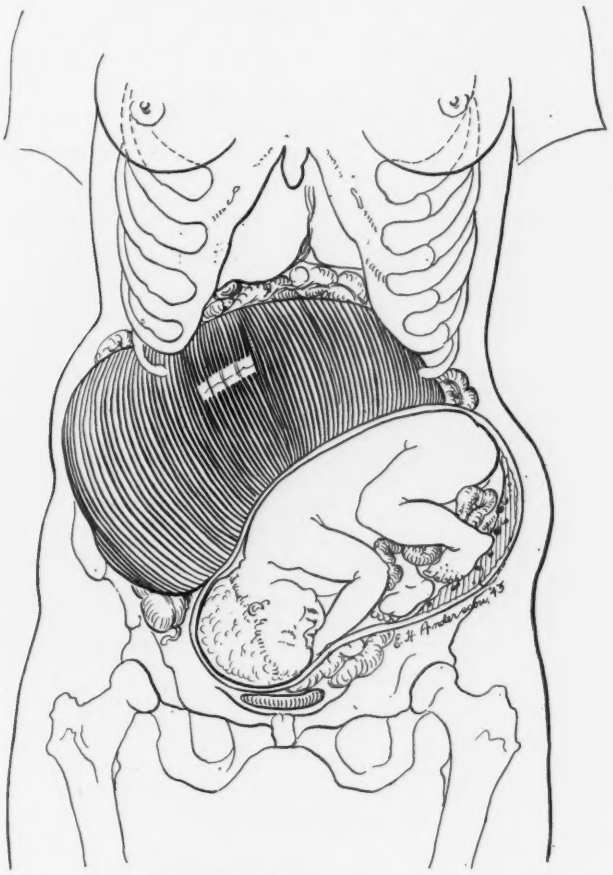


Fig. 1. B, diagrammatic illustration of *x*-ray Figure 1A.

ovarian masses. Supracervical hysterectomy with double salpingo-oophorectomy was performed together with incidental appendectomy. Sulfathiazole powder, 75 gr., was dusted into the pelvis. The abdomen was sutured in layers. Postoperative convalescence was smooth. The patient was discharged on the fourteenth postoperative day and the incision was well healed. She was last seen in the Out-Patient Department of the hospital on September 8, 1942, at which time it was noted that the patient was well and free of complaints.

Pathological diagnosis stated that there was a dermoid cyst of the right ovary with old rupture, peritoneal implantations and subacute and chronic pelvic peritonitis, involution of the uterus, lutein cyst of the left ovary, and subacute and chronic peri appendicitis.

Case II. Mrs. O. M. Del., No. 77519, age nineteen, para 1, was admitted to Malden Hospital, on December 27, 1942 and discharged January 16, 1943.

This case illustrates the rapid increase in size that may be attained by an ovarian cyst during pregnancy. It is interesting in that the patient delivered normally a seven pound male at term followed by an ovariotomy eight days postpartum for a cyst containing fourteen quarts of fluid.

The patient was referred to me by Dr. John Verdone, of Medford, in her seventh month of pregnancy with the history that there had been a tremendous increase in the size of the abdomen during the preceding one and a half months. Her only other complaint was moderate dyspnea. Examination revealed a tremendous tense abdomen all out of proportion to the expected size of a seven months' pregnancy; the enlargement was due to fluid that was extra-uterine since the gravid uterus was palpated through the lower abdominal half. *X*-rays of the abdomen taken on November 20, 1942, (Figs. 1 and 2) revealed the infant

occupying an abnormal position in the lower part of the abdomen due to pressure from a mass overlying it. Diagrammatic illustrations under gas, oxygen, anesthesia. A midline incision four inches in length was made half way between the umbilicus and pubis. When

FIG. 2. A, *x*-ray photograph (lateral view) of Case II again revealing the abnormal position taken by the fetus because of increased pressure upon it by a large ovarian cyst.

(Figs. 1A and 2A) show this condition. Since the patient had no untoward symptoms it was believed best to follow her carefully and await labor with the view of performing cesarean section and ovariotomy if labor was abnormal. She, however, delivered normally a live seven pound male child on December 28, 1942. After delivery the abdomen was still tense and enlarged by a tremendous globular mass occupying the whole abdomen. Operation was carried out on the eighth post-partum day.

Operation was performed on January 5, 1943, the abdomen was opened it revealed a large tense cyst, filled with fluid, occupying the whole abdomen. The removal of fourteen quarts of clear fluid collapsed the cyst; its sac was then delivered out of the abdomen revealing it to be right ovarian in origin; its pedicle was clamped, cut and transfixed. The right Fallopian tube was removed. Incidental appendectomy was also performed. The left tube and ovary were normal. The abdomen was sutured in layers and the immediate postoperative condition was excellent. Pathological

examination was that of a simple cyst of the ovary measuring 32 by 32 cm. in the flattened state. The cyst was inflated with air (Fig. 3)

Fig. 2. B, diagrammatic illustration of *x*-ray Figure 2A.

for photographic purpose. The postoperative course was complicated by P.M. rise of temperature to 101°F. for the first four days due to foul endometrial discharge. She was discharged as well on the eleventh postoperative and fourteenth postpartum day.

Case III. Mrs. R. DeV., No. 78516, age twenty-nine, was admitted to the Malden Hospital on March 12, 1943, and discharged March 26, 1943.

This case illustrates the possible complication that may occur from an ovarian cyst complicating pregnancy at two months.

This twenty-nine year old female, referred by Dr. J. Verdone, was admitted into the Malden Hospital on March 12, 1943, with the history of miscarriage at home on March 7, 1943 followed by the development of severe pains to the right lower quadrant, accompanied by pyrexia ranging from 102 to 105 degrees until the date of hospital admission. Examination at this time revealed a well marked, hard, tender mass the size of an orange seemingly attached to the right of the uterine fundus. (Appendectomy had been performed eight years previously.) Laboratory data on the day of admission was white blood count 11,800, 84 per cent polymorphonuclears on smear, red blood count 4,710,000, hemoglobin (S) 94 per cent. A preoperative diagnosis of ovarian cyst with abscess or uterine fibroid was made.

Operation was performed on March 13, 1943, under spinal anesthesia. A midline incision was made. The peritoneum was opened and inspection revealed an ovarian

cyst the size of an orange adherent to the fundus of the uterus. The intestines were packed away from the pelvis with two three-yard strips. The cyst was shelled out from the uterus, and on doing so it ruptured pouring forth thick greenish pus. A culture was taken. Sulfanilamide, gr. 75, was sprinkled about the pelvis and the abdomen sutured in layers without drainage. The immediate postoperative condition was good.

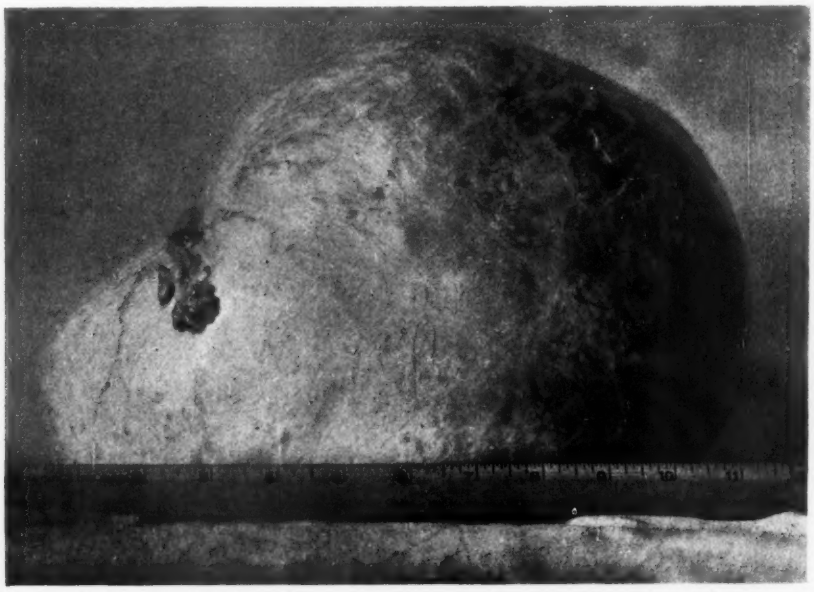


FIG. 3. Photograph of specimen (ovarian cyst) removed on the eighth postpartum day in Case II.

The culture from pus of ovarian cyst, taken during course of operation, was reported on March 15, 1943, as showing growth of hemolytic streptococci.

The postoperative convalescence was complicated by a rise of temperature to 103.8°F. on the sixth day. At this time a probing of the incision was followed by the discharge of about 8 ounces of thick pus, culture of which showed a growth of hemolytic streptococci. The temperature rise promptly subsided thereafter and the patient's condition improved remarkably. Two blood cultures taken during convalescence showed no growth in forty-eight hours and ninety-six hours, respectively. She was discharged on the thirteenth postoperative day.

Pathological report of specimen removed stated that there was an ovarian cyst measuring 8 cm. by 8 cm. in the flattened state. The wall of the cyst was fibrous and throughout it there was an acute inflammatory hemorrhagic process.

SUMMARY

1. The presence of an ovarian cyst is not incompatible with normal pregnancy, labor or puerperium.

2. The usual complications of ovarian cysts occurring in the non-pregnant is more apt to occur in the pregnant.

3. Ovariotomy is indicated in every case of pregnancy complicated by an ovarian cyst. It should not be done during the first three months of pregnancy because of the possibility of removing the corpus luteum which is usually followed by abortion. If the presence of the cyst is first diagnosed in the last months of pregnancy, one of two courses would seem to be indicated: either to wait until full term and then to do a cesarean section and ovariotomy, rather than subject the cicatrix of a recent operation to the strain of labor; or else, if labor and delivery promise to be uncomplicated, to let them occur normally and then to do an ovariotomy early in the puerperium. When the diagnosis of ovarian cyst is first made in the puerperium, ovariotomy should be performed forewith.

REFERENCES

Andrews, Nicholls and Nicholls. Bilateral ovarian dermoids complicating pregnancy. *Am. J. Obst. & Gynec.*, 39: 453, 1940.

Bowles. Bilateral ovarian cysts complicating pregnancy. *West. J. Surg.*, 50: 78, 1942.

Caverly. Ovarian cysts complicating pregnancy. *Am. J. Obst. & Gynec.*, 21: 566, 1931.

Eiss. Ovarian cysts. *Am. J. Surg.*, 10: 338, 1930.

Gemmell. Ovarian cysts in pregnancy. *Am. J. Obst. & Gynec.*, 28: 603, 1934.

Helwig. Ovarian cysts complicating pregnancy. *Northwest Med.*, 39: 180, 1940.

Laffant. Ovarian cysts. *Bull. Soc. d'obst. et gynéc.* 23: 508, 1934.

Linn. Dermoid cysts. *Am. J. Obst. & Gynec.*, 41: 328, 1941.

Litzenberg. Ovarian cysts complicating pregnancy. *Am. J. Surg.*, 3: 506, 1927.

Nucci. Ovarian cysts in pregnancy. *Pennsylvania M. J.*, 45: 1059, 1942.

Tiber. Ovarian cysts in pregnancy. *West. J. Surg.*, 44: 696, 1936.

Wilson. Pregnancy complicated by ovarian and paraovarian tumors. *Am. J. Obst. & Gynec.*, 34: 977, 1937.

Albucasis gives the first reference to an intra-abdominal pregnancy in the form of a case report. He had seen a pregnant woman whose foetus had died without being expelled. She became pregnant the second time, and again the foetus died. Some time later, the patient developed an umbilical abscess which ruptured, expelling a large number of small bones. She recovered, but the fistulous track remained.

UTEROGRAPHY

AN AID IN THE DIAGNOSIS OF GYNECOLOGICAL PELVIC DISORDERS

BEN H. BRUNKOW, M.D.
On Staffs of St. Vincent's and Billing's Deaconess Hospitals
BILLINGS, MONTANA

UTEROGRAPHY as a diagnostic procedure is a comparatively new method of diagnosis used in gynecology. Six years ago it was not used in some of the medical schools or in a large number of teaching hospitals. In a survey of the medical publications since 1937 there have been several articles written on the technic of this procedure but only two articles were found published in this country on it as a means of diagnosis. Foreign literature, especially French, Italian, and German during this time have a considerable number of articles relative to this procedure.

It is with the purpose of bringing before the profession a brief résume of the technic, the results and the benefits derived from this valuable procedure that prompted the author to write this article.

Material for this paper was taken from a review of a hundred unselected cases from the files of a clinic, these cases occurring during the year 1940. It is admitted that this is a comparatively small number of cases from which to draw conclusions, but it is representative. Since 1935, this procedure has been used extensively in this clinic and over this period of time several thousand cases have been examined. It is also conceded that these results are not too definite, for histories were often incomplete and personal evaluations are prone to creep into a reviewer's interpretations.

Equipment. The equipment necessary for this procedure is an *x*-ray machine equipped with a Potter Bucky diaphragm, cassetts and: (1) small uterine sound, (2) cervical tenaculii—two, (3) uterine cannula equipped with a rubber tip on one end and a syringe connection on the other, (4) a 10 cc. syringe, and (5) 10 cc. of heavy brominal.

The choice of radio-opaque material is of some concern. The substance should be non-toxic, be quite quickly absorbed in the peritoneal cavity, give good contrast, and not be too thick causing difficulty in going through the tubes, neither should it be too thin so that it will flow too readily out of the tubes before pictures may be taken. Lipiodol has been used for this but it is absorbed very slowly, and there is some proof that it may produce some irritation of the tubal epithelium. Titus[1] and others recommend the use of a mixture of diodrast or neo-i-opax and acacia, or sterile lubricating jelly. They have shown it to be non-toxic and it is absorbed in about four hours. The heavy brominal was used in these cases studied in this clinic and it was found to be quite well absorbed in twenty-four hours. No undesirable after-effects have been noted in the cases in which this substance has been used.

Technic and General Consideration. Before this procedure is undertaken, a thorough history and physical examination should be made. A big contraindication for this procedure is pregnancy, and although one may watch for this condition diligently to avoid doing this procedure at such a time, occasionally a pregnant uterus will be injected. This was done accidently in two cases in the series observed; one of these went to term without interruption while the other had a miscarriage shortly after the procedure. A third case had symptoms very suggestive of a miscarriage after a uterography and a placental-like mass was extruded which proved to be a

degenerating fibroid. Apparently the procedure caused it to loosen its attachment to the uterus.

time. A roentgenogram is taken immediately after each injection. The usual number of *x*-ray exposures is three or four,

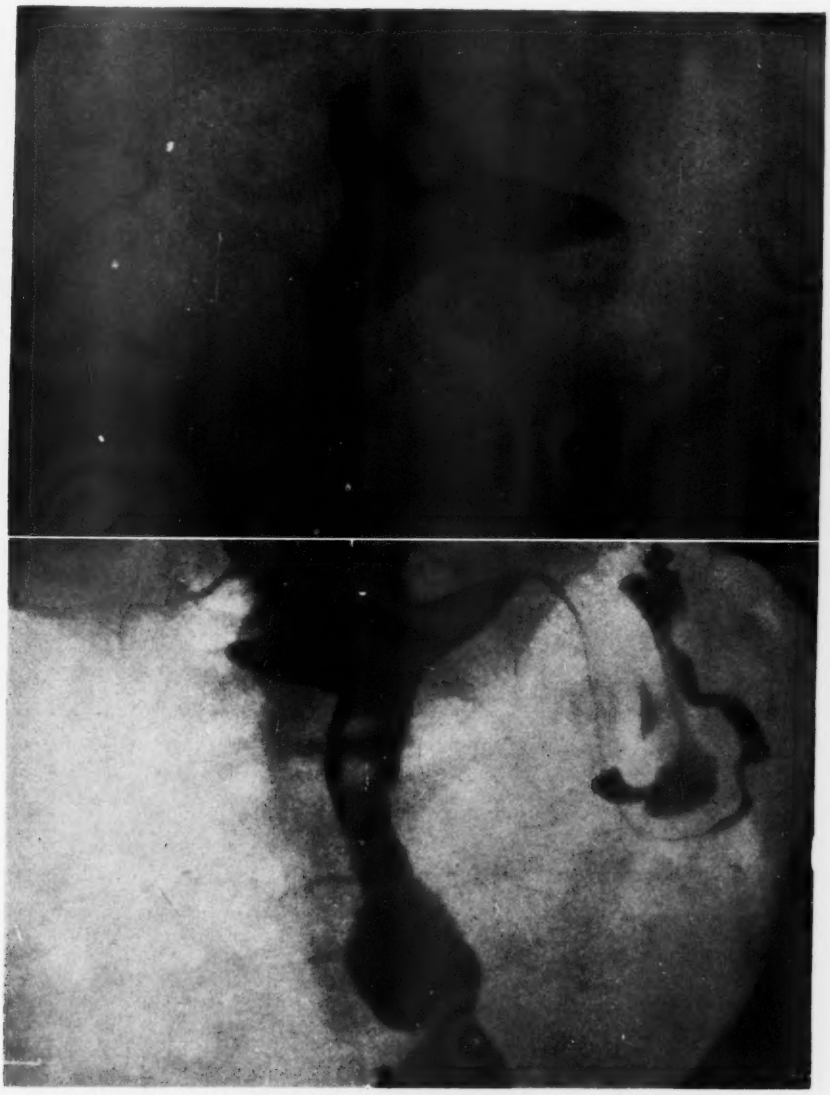


Fig. 1.

Fig. 2.

Fig. 1. Normal uterogram. Note the smooth uniform uterine cavity, narrow cervix and string-like lumen of the Fallopian tubes.

Fig. 2. Intrauterine polypii, hydrosalpinx grade 1 and endocervicitis. Note the dilated cervical canal with roughened borders, the two polypii or submucous fibroids in the lower segment of the uterus and the smooth sausage-like dilatation of the end of the Fallopian tube on the left. The right tube did not fill; it was probably occluded by previous inflammatory disease.

With the patient in lithotomy position the cervix is exposed and grasped with the tenaculii and the cervical canal explored with a small sound. The tip of the uterine cannula is inserted into the cervix pushing it firmly up to the rubber stopper and held in place with the two tenaculii. About 2 cc. of the opaque material is injected at a

i.e., three anterioposterior and one lateral. Delayed emptying time of the material from the uterus or the Fallopian tubes may be checked at twelve to twenty-four hours after the injection. Normally they empty in twelve hours. Anesthesia is not necessary for this procedure, but occasionally for the nervous patient $\frac{1}{6}$ gr. of morphine

or one of the barbiturates aids greatly in this procedure. It is difficult or almost impossible to inject the radio opaque liquid into the cervical canal of a frightened or apprehensive patient. Undue force should not be used. Gentleness and patience will be rewarded by many more successful injections than will be obtained by a forceful procedure. This is an office procedure; however, the patient should not travel any great distance immediately following it and should remain quiet preferably in bed for at least twenty-four hours afterward.

FIG. 3. Hydrosalpinx on the left with normal spill of opaque material with puddling in cul-de-sac on the right. Note the smooth bordered sacular outline of the dilated tube on the left.

ANALYSIS OF CASES

In this study it is worthy of note that there were nearly twice as many diagnoses listed under *x*-ray departmental diagnoses as compared with that made by the clinician's diagnosis, and the *x*-ray diagnoses were much more specific.

Menorrhagia in some form or other is the most common single complaint found present in 16 per cent of the cases. Vaginal discharge came next, and irregular menses third in 10 and 8 per cent, respectively. Thirty-seven per cent of the chief complaints were menorrhagia, vaginal discharge, irregular menses and intramenstrual bleeding. These complaints are the most cardinal symptoms of carcinoma. These are some of the most common complaints a gynecologist hears. He should have some sure and easily performed diagnostic procedure to make or disprove the diagnosis of carcinoma.

A diagnosis of endocervicitis was listed in 16.5 per cent of the cases examined by *x*-ray as compared with 2 per cent having this condition in the clinical diagnosis. This is suggestive that this condition is present much oftener than is diagnosed clinically, and probably is responsible for more symptoms than it is credited with. Clinically, the diagnosis of pelvic inflammatory disease was made in 12 per cent of the cases, while the final diagnosis of salpingitis was made in only 6 per cent. The correction of the clinical diagnosis was made by surgery or *x*-ray. It is suggestive that this diagnosis is made too often in general practice. A diagnosis of salpingitis or hydrosalpinx was made in 7 per cent of the cases by *x*-ray. Most of these cases were of such degree that it would be impossible to feel the adnexa and diagnose the disease bimanually. The *x*-ray diagnosis of hydrosapinx and salpingitis given by

surgery closely corresponds, i.e., 7 per cent and 6 per cent, respectively.

A study was made of the final diagnosis as determined by operation, biopsy and by summary of the patient's chart. It is in the latter group in which the big error is likely to be present, for incomplete charts and follow-up records make conclusions almost worthless. It is in this group that a fair number of "undetermined" final diagnosis was made. The diagnosis, menopause, was made in those cases of that age group who had symptoms that were of the menopausal type and in whom some pathological condition could not be found. This occurred in 8 per cent of the cases. The clinical diagnosis of this condition was made in 2 per cent of the cases. Undoubtedly, the examining physician made a mental diagnosis of menopause at the time of his examination in a much higher per cent of the cases, but it is the practice of this clinic to make the diagnosis only after all other pathological disorders have been ruled out.

Intra-uterine polypii were present in 9 per cent of the total *x*-ray diagnoses. This condition cannot be accurately diagnosed clinically. In a study of these individual cases, the predominating symptoms were menorrhagia, metorrhagia and dysmenorrhea. When these symptoms occur in the younger age group intra-uterine polypii should be suspected more frequently.

In a comparison of clinical diagnosis and *x*-ray diagnosis, the records show a close approximation in the diagnosis of the normal uterus and tubes, i.e., 24 per cent and 22 per cent, respectively. Also the clinical and *x*-ray diagnosis of enlarged uterus of 15 per cent and 17 per cent, respectively, is verys imilar. There is a considerable difference in the clinical diagnosis of fibroid uterus and *x*-ray diagnosis of the same, i.e., 17 per cent and 5.6 per cent, respectively. However if one combines the *x*-ray diagnoses of uterine tumor of 9.9 per cent and fibroid uterus of 5.6 per cent, a total of 15 per cent is obtained which closely agrees with the clinical diagnosis of 17 per cent of the cases of this disease. Perusal of these two groups of cases shows they are not the same cases.

Fig. 4. Adenocarcinoma of the cervical canal. Note the marked irregularity and deformity of canal and uterine cavity. This is a characteristic picture resembling that seen in a roentgenogram of carcinoma in any cavity of the body.

It is admitted that the *x*-ray is of no great value in the diagnosis of fibroid uteri when such is large and easily outlined by the physical examination, but this is not true for the small or submucosal tumors.

COMMENT

Diagnostic procedures should be safe, readily available, comparatively simple to perform, exacting, and convincing to both doctor and patient. Uterography as a diagnostic method falls into this category.

Uterography is an office procedure requiring a relatively short time to perform and does not incapacitate the patient appreciably. When compared to the cost of curettage in a hospital, hospitalization and laboratory expense, it is a big saving

to the patient. There are many patients who will refuse to enter the hospital because of financial circumstances, aversion to hospitals or other reasons but few will refuse to submit to *x*-ray examinations. As shown above it is quite a reliable procedure, probably just as much so as that of curettage, for small lesions might well be missed by curettment. The large or late lesion is quite easily and accurately diagnosed by most methods. It is the small early lesion that is unfortunately easily missed. As a result of its low cost and ease of performance, suspicious lesions can be followed by recheck examinations at short intervals. Few patients will submit to two or more curettages in a relatively short time; most patients will return for *x*-ray study without urging if they know they have a suspicious lesion present in their body as demonstrated by an *x*-ray film. Roentgenograms taken at intervals make a valuable graph of the patient's progress. Shown to the patient her confidence in her physician will grow and his advice will be followed more diligently.

This procedure is of great value in ruling out pathological disorders preparatory to operative procedures, such as a laporatomy in which there might be some question whether the uterus should be removed or not, or before an interposition operation in an elderly patient. It can be a deciding factor whether to do a hysterectomy in a given case or to give *x*-ray therapy for fibromyomas of the uterus.

FIG. 5. Intramural fibroid of the uterus. Note enlarged deformed uterine cavity with displacement of opaque material in the center. This tumor could not be palpated by bimanual examination. The clinical diagnosis was "Uterus somewhat enlarged, cause?"

The diagnosis of carcinoma of the cervical canal or fundus of the uterus can be made or ruled out for the cautious doctor or for the cancerphobia patient. Both doctor and patient can rest assured of no serious disorder as shown by a normal uterogram.

Patent or closed tubes as shown by this procedure aid in the diagnosis of sterility. The clinic in which this study was made has observed that pregnancy followed uterography in a fair number of cases in which it had been used as a diagnostic procedure to determine the cause of sterility. It is gratifying to the wishing "would be mother" to know that her pelvic organs are normal. This information may cure some neurosis or iron out some family difficulties.

In the diagnosis of carcinoma of the cervical canal or fundus this procedure has been very reliable. In one case in

which the *x*-ray diagnosis was a carcinoma of the fundus, the surgeon made a similar diagnosis from the gross specimen and it was not until the pathological report came back as, "Hypertrophic polypoid endometrium" that the correct diagnosis was made. Here probably curettage would have been the better procedure but such cases are rare indeed.

In the treatment of carcinoma elsewhere in the body the surgeon does not first curette the lesion and then remove it. Why then with this condition present in the cervix of the uterus should curettage be recommended when there is an equally reliable and safer method available? It is the contention of this clinic that there is little or no danger of dissemination of cancer cells by uterography, while curettment, even when followed by immediate hysterectomy, is quite likely to spread the deadly disease.

Where uterography is followed by curettment in a case in which a polyp is known to be present, curettage is likely to be done more thoroughly and properly if the surgeon knows ahead of time what is present and where the lesion is to be found.

The argument that the procedure may introduce infection into the uterus and the pelvis or light up an old latent infection already present is a real one. However, in patients who were operated upon shortly after uterography had been done, no definite evidence of infection was present. Also there were no cases of pelvic infections following surgery. Occasionally, patients were made uncomfortable with considerable pelvic distress for a few days following the brominal injection. This clinic has never had a mortality from this procedure. There has been no oil emboli at any time.

The roentgenograms in the figures are only representative of certain lesions. Most uterine lesions can be diagnosed quite easily by anyone having an average amount of training in roentgenographic interpretation. As in all procedures, practice makes perfect; numbers of uterograms viewed will bring confidence and perfection.

CONCLUSIONS

1. Uterography is a safe, useful method to use as an aid in the diagnosis of gynecological disorders. Its use will result in a much greater accuracy and specificity of diagnosis. Its use will reveal intra-uterine disorders earlier and easier than any other single diagnostic measure the medical profession has to date.

2. Due to the lessened cost and convenience to the patient as compared to curettage many more examinations will be made where this procedure is used. It is only by being thorough in one's diagnostic methods that a late, undesirable end result with its morbidity and mortality can be prevented.

3. A good history and physical examination gives a high percentage of correct diagnosis in conditions such as, fibroid uterus, enlarged uterus and gross adnexal disorder, but falls short in the diagnosis of endocervicitis, intra-uterine tumors, carcinoma, and the chronic forms of adnexal disease in which the pathological process is not readily palpable.

4. As in all technical procedures, this is an aid to diagnosis and not a supplement to a history, physical examination and good clinical judgment.

REFERENCE

1. Titus, P., McClellan, R. H., Tafel, R. E. and Loy, E. C. *Am. J. Obst. & Gynec.*, 37: 495–498.

SULFATHIAZOLE THERAPY IN GENERAL SURGERY

G. SAMUEL SERINO, M.D.
Chief of Surgical Service, St. Francis Hospital
WILMINGTON, DELAWARE

A SIGNIFICANT feature of modern surgery is the widespread interest and activity displayed in the study and investigation of the causes of post-operative morbidity and mortality. The combined resources of the medical and collateral sciences have been called upon to discover causes of surgical morbidity and to aid the surgeon in finding safe guards for the protection of the patient before, during and after operation. As a result of such research new principles, methods and therapeutic suggestions have arisen.

Sulfonamide therapy is a most recent product of such research. Its application to surgical disorders is based upon a sound surgical principle. The sulfonamides are bacteriostatic agents. Chemotherapy is not a substitute for well established surgical principles but is an additional weapon used in the constant battle against infection.

A clinical survey of 207 sulfathiazole treated surgical patients is presented. Sulfathiazole, the thiazole derivative of sulfanilamide, was selected as the chemotherapeutic agent of choice for the following reasons: (1) Very few surgical reports concerning the drug were available at the time this study was undertaken, this being the newest addition to the chemotherapeutic group of drugs. (2) The wide range of usefulness of sulfathiazole from a bacteriologic viewpoint as compared with sulfanilamide and sulfapyridine. (3) Experimental evidence by Reinhold, Flippin and Schwartz[1] proving that its use therapeutically is more easily controlled, because sulfathiazole is absorbed more readily and excreted more rapidly than sulfapyridine. (4) Acute toxicity of sulfathiazole is about half that of sulfapyridine, according to the results of Long, Perrin, Haviland, James and Edwards.[2]

MODE OF ACTION

Various reports have appeared concerning the mode of action and therapeutic activity of the sulfonamide compounds. Long and Bliss[3] in one of their original articles showed that sulfanilamide in certain concentrations, when placed in contact with cultures containing beta hemolytic streptococcus definitely inhibited multiplication of the organisms. Long and Bliss[4] in a later report conclude that there is no bactericidal effect in the action of sulfanilamide and decide that the serums of patients treated with sulfanilamide exert little if any bactericidal effect on beta hemolytic streptococci. There is a definite bacteriostatic effect *in vitro* as well as *in vivo* and these authors ascribe to phagocytosis the so-called clean-up roll.

J. S. Lockwood[5] has demonstrated that phagocytosis is not necessary to interfere with bacterial growth. Interference takes place to the same extent in human serum which contains no phagocytes. He has also shown that the presence of peptone is important in the action of sulfanilamide. He concludes that sulfanilamide acts upon hemolytic streptococci by interference with their protein digesting mechanism. This accounts for the fact that sulfanilamide is of greatest value in lesions in which there is a minimum of tissue destruction. In a later and comprehensive report Lockwood[6] comes to the following conclusions: "This bacteriostatic effect is probably a result of a specific interference with the enzymatic utilization by the bacteria of some nutritive chemical factor, such as P-Amino-benzoic acid, these substances, the utilization of

which is blocked by sulfonamide, will act as inhibitors of sulfonamide effects when they are present in more than minimal concentrations."

DOSAGE AND ROUTES OF ADMINISTRATION

No attempt was made to adhere to a rigid dosage schedule. The necessity of administering the drug in doses sufficient to bring about the therapeutic effect was particularly emphasized. The following figures cite in a general fashion the dosage utilized in this series of surgically treated cases. Severe infections, such as, staphylococcic cellulitus, lymphangitis, and severe cases of peritonitis received an initial dose of 3 Gm. of sulfathiazole. This dosage was repeated in four hours followed by doses of 1 Gm. every four hours, day and night, as long as evidence of a spreading infection continued. Drug therapy was discontinued forty-eight to seventy-two hours after subsidence of the infection. In moderately severe infections an initial dose of 2 Gm. was given. This dose was repeated in four hours, following which 1 Gm. doses were administered every four hours. Therapy was continued in many of these cases for a period of two to five days after all clinical evidences of the disease had disappeared.

The dosage of sulfathiazole crystals locally implanted in wounds varied from 0.5 to 12 Gm. The extent and severity of the wound serving as a guide to dosage.

Sulfathiazole is readily absorbed when given by mouth. It is also rapidly distributed in the tissues and body fluids, with the outstanding exception of the cerebrospinal fluid. As a result, the oral method of administration was favored in all these cases. Utilization of intravenous sodium sulfathiazole was reserved for the immediate postoperative period and for those cases in which drug therapy was not tolerated by mouth. The dosage schedule for intravenous therapy did not vary from that procedure as described above. The sodium salt of sulfathiazole in amounts of 2 or 3 Gm. was dissolved in 500 cc. of distilled water. A dosage of 1 Gm. was dissolved in 100 cc. of distilled water. These were given by the slow continuous drip method. Alkali therapy so often administered with sulfathiazole was omitted in this series of cases.

LABORATORY STUDIES

Complete blood counts and hemoglobin in determinations were routinely performed on admission of the patient to the hospital. These studies were repeated daily or every second or third day, depending upon the status of the individual case. Determinations of sulfathiazole concentrations in the blood were carried out daily in a majority of these patients. These concentrations varied from 5 to 15 mg. per 100 cc. of blood. Concentrations in the blood plus the general clinical survey of the patient served as a guide to control the administration of the drug.

Routine urine analyses were performed on admission. Gross examination of the urine was performed daily in all cases. Chemical and microscopic examinations were performed every second or third day. Particular attention was directed toward the observation of gross or microscopic hematuria. Maintenance of an output of 1,000 cc. or more of urine in twenty-four hours was particularly stressed. Other laboratory procedures were utilized as indications in individual cases demanded. These included blood cultures, blood chlorides, plasma protein, carbon dioxide combining power, prothrombin determinations, etc.

CLINICAL USE

A total of 207 surgical cases were treated with sulfathiazole. For purposes of discussion these cases are divided into the following groups: (1) Peritonitis of appendiceal origin; (2) traumatic wounds; (3) lymphangitis and cellulitis; (4) carbuncles; (5) burns; (6) chronic leg ulcers. This grouping is based upon a clinical and pathologic diagnosis. According to Lockwood[7] the pathologic character of the

infectious lesion is of primary importance in determining the effectiveness of sulfonamide therapy.

Peritonitis of Appendiceal Origin. One hundred and ten patients presenting peritonitis associated with appendicitis comprise the largest group. These patients were observed twice daily. Particular attention was directed toward any possible toxic effects resulting from the administration of sulfathiazole. Other needs of these surgical patients from a modern surgical viewpoint were duly considered in each instance. These included surveys directed toward maintenance of proper fluid, electrolyte, protein and vitamin balance. Ravdin[8] in a recent report states that "no consideration of fluid and electrolyte loss and their restitution is sufficient unless the plasma protein is simultaneously considered." This viewpoint was considered in treating these patients. Blood or plasma transfusions were administered to meet individual requirements in which anemia and hypoproteinemia were factors.

Five per cent glucose solutions in normal saline were utilized by the continuous drip method, giving nothing by mouth, in severe cases. Suction drainage, oxygen and vitamin therapy were employed to meet individual demands. Oxytocic drugs were avoided. Morphine was routinely administered. Orr[9] concludes that morphine stimulates rhythmic contractions of intestinal muscle and raises the muscle tone as evidenced by increased intraluminal pressure. However, this same author[10] in a later report concludes that morphine may be given with assurance in the treatment of peritonitis not only to increase muscle tone but to make the patient comfortable, promote rest, relieve anxiety and minimize thirst.

Positive cultures for the following organisms were obtained, Bacillus coli, Streptococcus hemolyticus, Streptococcus non-hemolyticus, and staphlococcus. No attempt was made to classify these cases into local, spreading or general peritonitis. Ravdin, Rhoads and Lockwood[11] believe that little can be gained from such a classification since the most important problem in appendicitis is infection. The difference between the various types being one of degree.

Appendectomy was performed in all of these cases. Drainage was used in thirty-two cases. One patient died in this group, a mortality rate of 0.9 per cent. A similar series of 130 cases of peritonitis were analyzed for comparison. Appendectomy was performed in each case. Drainage was employed in fourteen cases. All factors were constant with the exception that sulfathiazole therapy was omitted in this latter series. There were three deaths in this series, a mortality rate of 2.1 per cent. Convalescence was smoother in the sulfathiazole treated patients. Sulfathiazole treated patients were hospitalized for an average period of 4.5 days less than the untreated series. A lowering of the mortality rate, and a very definite decrease in the morbidity rate is revealed as a result of this analysis between sulfathiazole treated and untreated patients with peritonitis of appendiceal origin.

TABLE 1

CLINICAL CLASSIFICATION OF 207 SURGICAL PATIENTS TREATED WITH SULFATHIAZOLE

Indications	No. of Patients
Peritonitis of appendiceal origin	110
Traumatic wounds	49
Cellulitis and lymphangitis	19
Burns	7
Carbuncles	5
Chronic leg ulcers	17
Total	207

Intraperitoneal implantation of sulfathiazole was not utilized in this series. That the mortality and morbidity rate might still be more favorably influenced by this procedure is highly encouraging. Rosenberg and Wall[12] believe that sulfanilamide is not irritating to the peritoneum and that it is advantageous in obtaining a high concentration of the drug in the peritoneal cavity at the time of and immediately following operation. Mueller and Thompson[13] report a series of 268

patients with acute appendicitis treated by intraperitoneal therapy without a death. Jackson and Coller[14] state that there is no evidence that local application intraperitoneally injures the peritoneal surfaces, and suggest that chemotherapy offers promise of reducing adhesion formation in the peritoneum secondary to pyogenic infection.

Traumatic Wounds. It has been established by Jensen, Johnsrud and Nelson[15] that under certain conditions there are distinct advantages in applying sulfonamide compounds directly to tissues. Diveley and Harrington[16] more recently reported a series of fifty-six cases with infected bones and soft tissues treated by both systemic administration and local implantation of sulfathiazole with highly successful results. The chief virtue of such a procedure according to Spink and Paine[17] is that it provides much higher concentrations of the drugs in a relatively small area than can be obtained when the drugs are administered orally or parenterally. These higher concentrations may overcome, at least in part, factors that inhibit the antibacterial action of the compounds. According to Lockwood[6] the curative effects of sulfonamides are maximal when the concentration of the drug is high, when the local cellular defense is active, and when the concentration of sulfonamide inhibitors in the infected area is low.

In order to obtain this optimum therapeutic result in these forty-nine patients presenting traumatic wounds, the following principles and procedures were followed: Attention directed toward the general supportive care of the patient; débridement and irrigation of the wound; immobilization of the affected area; sulfathiazole locally applied, and supplemented by oral administration in most cases. Infection developed in the first of five compound fractures treated. Difficulty was experienced early in treating these traumatic wounds. The first case treated by local chemotherapy was a traumatic wound of the back. Following adequate débridement and irrigation the wound was sprinkled with sulfathiazole. The wound was closed and the drug placed along the suture line in order to prevent a stitch abscess. Solidification of the drug plus trauma from movements while sleeping produced a mild pressure necrosis of the skin. This practice was discontinued for those regions which could not be properly controlled. Solidification (caking) of sulfathiazole producing interference with wound healing was experienced in the first six patients treated. Removal of the drug resulted in satisfactory closure. An excess amount of serum was encountered in five wounds. This was expressed and convalescence was uneventful. This early experience with caking of sulfathiazole in the wound brought up these questions: Does sulfathiazole as a result of solidification act as a local mechanical irritant? Does this process alter the local absorption of the drug? How can this effect be overcome? Will minimum implantation locally plus oral therapy prove adequate in providing a sufficiently high local concentration of the drug to prevent or overcome existing infection?

As a result of this early experience the patients who followed were treated locally with much smaller amounts of the drug, supplementing the drug by oral administration. This solved the annoying problems which were presented. Satisfactory results were obtained. There was no interference with wound healing and no infections were encountered following this procedure. Ferguson,[18] in a recent report, states that this new preparation, microsulfathiazole, will eliminate these objectionable features observed when sulfathiazole is applied locally in wounds.

Cellulitis and Lymphangitis. The results of therapy in nineteen patients with cellulitis and lymphangitis were unusually satisfactory. Two patients with cellulitis had severe attacks of the disease with extensive involvement, edema, high fever and toxemia. Blood cultures were all negative. Treatment consisted of intensive doses of

sulfathiazole maintaining a high concentration of the drug. General supportive measures combined with immobilization, elevation and the application of wet dressings were employed. Surgical interference was avoided. A definite improvement was noted forty-eight hours following chemotherapy. There were no deaths in this group.

Carbuncles. Five patients presenting large carbuncles were treated by surgical excision. There was a striking difference in response relative to healing between the two patients treated locally with chemotherapy and those packed with vaseline gauze only. This latter group required on an average of eight days longer for complete healing. The wounds looked cleaner and the patients were more comfortable when treated by local sulfathiazole therapy. According to Lockwood[6] localized areas of tissue necrosis and abscess contain large quantities of sulfonamide inhibitor. The organisms within such lesions are protected against the effects of sulfonamides. Of great importance is the surgical treatment of sulfonamide resistant lesions.

Burns. This group consisted of seven severely burned patients. The early management of these patients consisted of débridement, tanning and the use of thermoregulated heat over the affected area. Plasma transfusions and adrenal cortical extract as advocated by Rhoads, Wolff and Lee[19] were also administered. Three of these cases became infected. Sulfathiazole was applied sparingly to the denuded surface because of the possible danger of too rapid absorption of the drug. Skin grafts were successfully used in these cases after the field had been treated by chemotherapy. A fourth patient presenting slight evidence of infection over a large burned area of the trunk and upper extremities was considered as a possible case for local sulfathiazole therapy. However, due to large denuded areas present in this child of six years of age, fear was expressed concerning rapid absorption of the drug resulting in toxic manifestations. As a result sulfa therapy was not used. The child died suddenly twenty-one days following the burn. Postmortem examination revealed the presence of multiple perforated stomach ulcers, non-perforated duodenal and jejunal ulcers, and peritonitis. An acute ulcer of this type occurring in the duodenum is called a Curling's ulcer. These acute ulcers according to DaCosta[20] occur late following an extensive burn and are probably due to sepsis. Sulfathiazole therapy might have prevented a fatality in this patient. Of equal importance is the finding of this rare ulcer.

Chronic Leg Ulcers. These lesions are commonly the site of low grade mixed infection. The purulent stage in seventeen chronic leg ulcers were controlled by applying sulfathiazole directly over the wound. Epithelialization was hastened in two cases by placing pinchgrafts in the granulating area. Saphenous ligation preceded local chemotherapy in five instances. The results in this group were highly satisfactory.

TOXIC EFFECTS

Toxic symptoms referable to sulfathiazole therapy were comparatively rare and mild. They were noted in twenty-seven, or 13 per cent of the 207 patients treated. There were no deaths in this series as a result of toxicity from sulfathiazole therapy.

Nausea and Vomiting. During sulfathiazole administration nausea and vomiting were noted in 2.9 per cent of the patients. In no instance was this symptom severe enough to necessitate discontinuance of the drug.

Cyanosis. This was observed in 4.8 per cent of the patients. This was of a mild degree in all cases. No difficulties were experienced from this source.

Drug Fever. The appearance of this toxic manifestation occurred in 2.4 per cent of the patients. This was sufficient reason to discontinue the drug and force fluids.

Dermatitis. This was observed in three patients. Dermatitis appeared between

the sixth to the ninth day of therapy. These cleared up with the discontinuance of the drug.

Leukopenia. A drop in the leukocyte count to below 4,000 per cubic millimeter was noted in two patients. This occurred early in our series. The drug was continued without producing any serious disturbances. Long et al.[21] state that no deaths have been reported from disturbances of the white cells during the first twelve days of chemotherapy.

Hematuria. Microscopic hematuria was noted in one patient on the eighth day of therapy. Gross hematuria was not observed in any of these patients. Chemotherapy was discontinued in this patient. Convalescence was uneventful.

Acute Agranulocytosis. This rare toxic manifestation was not encountered in this series. It is of interest from the viewpoint that no deaths from acute agranulocytosis were reported following sulfathiazole therapy up to June, 1941. At this time Hoyne and Larimore[22] reported the first uncomplicated case in which acute agranulocytosis developed after prolonged medication with sulfathiazole, terminating in death.

Table II
INCIDENCE OF TOXIC REACTIONS (207 CASES)

Toxic Effect	No. of Cases	Per Cent
Nausea and vomiting, mild	6	2.9
Cyanosis, mild	10	4.8
Dermititis	3	1.4
Drug fever*	5	2.4
Leukopenia	2	0.9
Hematuria, microscopic*	1	0.5
Hematuria, gross	0	0.0

* Drug discontinued, fluids forced.

CONCLUSIONS

1. Rigid adherence to surgical principles must be followed in all instances in which chemotherapy is employed.

2. Surgery combined with sulfathiazole therapy has reduced the mortality and morbidity rate in peritonitis of appendiceal origin.

3. Surgical lesions characterized by a minimum of tissue destruction as seen in cellulitis and lymphangitis respond unusually well to chemotherapy.

4. The caking effect of sulfathiazole may produce interference with local wound healing.

5. Wound infections present in chronic leg ulcers and burns can be satisfactorily controlled by local chemotherapy.

REFERENCES

1. Flippin, Harrison F., Schwartz, Leon and Rose and Brandt, S. The comparative effectiveness and toxicity of sulfathiazole and sulfapyridine in pneumococcic pneumonia. *Ann. Int. Med.*, 13: 2038, 1940.
2. Long, Perrin H., Haviland, James W. and Edwards, Lydia B. Acute toxicity, absorption and excretion of sulfathiazole and certain of its derivatives. *Proc. Soc. Exper. Biol. & Med.*, 43: 328, 1940.
3. Long, Perrin H. and Bliss, Eleanor A. Para-amino-benzene-sulfonamide and its derivatives. *J. A. M. A.*, 108: 32, 1937.
4. Bliss, Eleanor A. and Long, Perrin H. Observations on the mode of action of sulfanilamide. *J. A. M. A.*, 109: 524, 1937.
5. Lockwood, J. S. Observations on the mode of action of sulfanilamide and its application to surgical infections. *Ann. Surg.*, 108: 801, 1938.
6. Lockwood, J. S. Sulfonamide therapy as an aid to surgery. *Surg., Gynec. & Obst.*, 72: 307, 1941.
7. Lockwood, J. S. Sulfanilamide in surgical infections its possibilities and limitations. *J. A. M. A.*, 115: 1190, 1940.
8. Ravdin, I. S. Hypoproteinemia and its relation to surgical problems. *Ann. Surg.*, 112: 576, 1940.
9. Orr, T. G. The action of morphine on the small intestine and its clinical application in the treatment of peritonitis and intestional obstruction. *Ann. Surg.*, 98: 835, 1933.
10. Orr, T. G. Treatment of peritonitis. *J. A. M. A.*, 113: 1489, 1939.
11. Ravdin, I. S., Rhoads, J. E. and Lockwood, J. S. The use of sulfanilamide in the treatment of peritonitis associated with appendicitis. *Ann. Surg.*, 111: 53, 1940.
12. Rosenburg, S. and Wall, N. M. The treatment of diffuse peritonitis by the direct intraperitoneal introduction of sulfanilamide. *Surg., Gynec. & Obst.*, 72: 568, 1941.
13. Mueller, R. S. and Thompson, James E. The local use of sulfanilamide in the treatment of peritoneal infections. *J. A. M. A.*, 118: 189, 1942.
14. Jackson, Howard C. and Coller, Frederick, A. The use of sulfanilamide in the peritoneum. *J. A. M. A.*, 118: 194, 1942.

15. Jensen, N. K., Johnsrud, L. W. and Nelson, M. C. Local implantation of sulfanilamide in compound fractures. Preliminary report. *Surgery*, 6: 1, 1939.
16. Dively, Rex L. and Harrington, P. R. Chemotherapy in infections of the bones and soft tissues. *J. A. M. A.*, 117: 1868, 1941.
17. Spink, W. W. and Paine, John R. The local use of sulfathiazole in the treatment of staphylococcal infections. *Minnesota Med.*, 23: 615, 1940.
18. Ferguson, L. K. Micro-sulfathiazole. Read Before the Joint Session of the Philadelphia and New York Academy of Surgery. Philadelphia, February, 1942.
19. Rhoads, Jonathan E., Wolff, William A. and Lee, Walter Estelle. The use of adrenal cortical extract in the treatment of traumatic shock of burns. *Ann. Surg.*, 113: 955, 1941.
20. DaCosta, John Chalmers. Modern Surgery. 10th ed., p. 85. Philadelphia, 1931. W. B. Saunders Co.
21. Long, Perrin H., Haviland, James W., Edwards, Lydia B. and Bliss, Eleanor B. The toxic manifestations of sulfanilamide and its derivatives. *J. A. M. A.*, 115: 364, 1940.
22. Hoyne, A. L. and Larimore, G. W. Sulfathiazole as a cause of death. *J. A. M. A.*, 117: 1353, 1941.

During this period (the late Middle Ages) the three pressing medical problems with which Europe had to contend were the care of lepers, the elimination of prostitutes, and the stamping out of the plague. This age succeeded in exterminating leprosy, though by most inhuman means. The plague raged furiously at times and decimated hamlet, city and country; but it had its crisis and abated. Prostitution remained perennial and unsolved. The ravages of venereal diseases from this source, the spread of disorderly conduct, and the moral decreptitude interested medical, secular and ecclesiastical authorities.

ANEURYSMS OF THE CORONARY ARTERIES

REVIEW OF THE LITERATURE AND REPORT OF A CASE

R. H. RIGDON, M.D. AND HARRIS VANDERGRIFF
University of Tennessee, Department of Pathology
MEMPHIS, TENNESSEE

BOUGON,[1] in 1812, reported the first aneurysm of the coronary artery. During the following 116 years only thirty cases are recorded according to the excellent review of Packard and Wechsler.[2] Snyder and Hunter,[3] in 1934, reviewed three cases of aneurysms of the coronary arteries published in the interval between 1928 and 1934 and added a fourth. Harris,[4] in 1937, reviewed the literature on aneurysmal dilatations of the coronary arteries. This author reports three cases from the literature which are not included in previous reviews and adds one additional case, making a total of thirty-eight recorded to 1937.

Six cases of aneurysms on the coronary arteries which have not been included in the previous reviews have been found in the literature.[5–10] Seven cases have been reported since 1937.[11–17] A grand total of fifty-one cases of aneurysms associated with the coronary arteries, therefore, has been recorded. In some of these reports the authors have used the diagnosis, "coronary aneurysm," very loosely. To illustrate, the case of Schuster[11] is an aneurysm of the sinus of Valsalva, only, with secondary involvement of the coronary artery.

In this paper as in any similar review, it is difficult to classify satisfactorily all the cases since sometimes the data are meager. The reviewers[2,3,4] have usually analyzed and discussed the individual cases of coronary aneurysms included in their papers. Packard and Wechsler[2] include considerable clinical data in their article. They find that (1) the condition is three times as common in males as in females; (2) etiologically, the cases can be divided into two main groups: mycotic-embolic and arteriosclerotic; (3) the mycotic-embolic aneurysms occur in association with an acute or subacute bacterial endocarditis of the aortic valve; (4) the average age is twenty-seven; (5) in the arteriosclerotic group, a marked coronary sclerosis is present; the average age is fifty-seven; (6) syphilitic meso-aortitis occurs in only three cases in their series; (7) trauma plays an insignificant etiologic rôle; (8) there are neither pathognomonic symptoms nor physical signs which make possible an antemortem diagnosis of a coronary aneurysm. Snyder and Hunter's[3] review is concerned primarily with a discussion of aneurysms arising in the sinus of Valsalva associated with syphilis. The case they report is syphilitic. Harris[4] discusses congenital anomalies of the coronary arteries in both man and some of the lower animals.

The following observations of Packard and Wechsler[2] are significant in the study of aneurysms of the coronary arteries: "When the aneurysm is single, it is practically always situated immediately beyond the coronary orifice, within the first inch of its course. The others, including the multiple aneurysms are usually found at the point of division of the artery." Forbus[18] has studied in detail the aneurysms that develop at the point of bifurcation of the medium size cerebral arteries. He concludes that these aneurysms develop in association with defects in the muscular coats which are located at the apex of the acute angle formed by the division of the vessel. Data are meager on the frequency in which this defect occurs in the medium size arteries. It was present in only two

coronary arteries in a group of nine cases, in two mesentery arteries in a group of nine cases and twenty-five times in thirty-

FIG. 1. A, the aneurysms located at the bifurcation of the left coronary artery are shown here. The thrombus in the circumflex branch is in the upper left hand corner of illustration. The infarction of the left ventricle is obvious. Lower insert shows aneurysms on the right coronary artery. The aorta is to the left.

three cases of cerebral arteries.[18] Muscular defects have been seen by Forbus[18] in the arteries of the kidneys and of the pulmonary system. He suggests that the muscular coat at the bifurcation of two vessels fail to fuse completely during embryonic life and that this defect constitutes a "locus minoris resistentiae" in the vessel wall. It is true that aneurysms may arise in the medium size arteries from causes other than congenital defects. It is most likely, however, that any aneurysm occurring either in or near a bifurcation of such a vessel develops as a result of this defect.

CASE REPORT

F. M. was a thirty-three year old colored male. Four days previous to his admission to the hospital he was awakened at 4:00 A.M. by a sudden substernal pain. This pain, during the first twenty-four hours following its onset shifted to the left chest and epigastrium. On admission, the patient complained of pain in

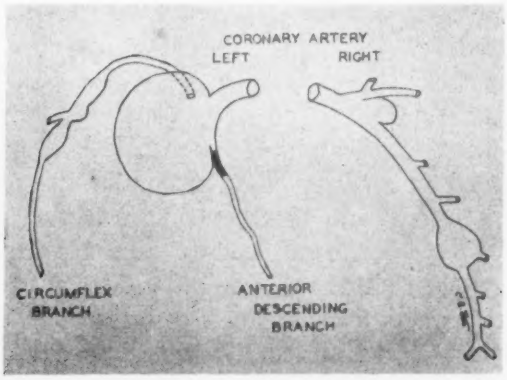


FIG. 2. A diagrammatic sketch of the location of the four aneurysms on the right and left coronary arteries.

the left chest and orthopnea. The temperature was 102°F., the pulse was 120, the respirations were 22 and the blood pressure was 80/60. He was well developed, alert, co-operative, and did not appear acutely ill. The heart was symmetrically enlarged and the sounds were distant. The cardiac rate was rapid but regular. The apex beat was present in the fourth and fifth intercostal spaces and extended 2.0 to 3.0 cm. on either side of the midclavicular line. An electrocardiographic tracing indicated the presence of an occlusion in the left coronary artery. Pulmonary congestion was present in the lower portions of the lungs at the time of his admission to the hospital.

The patient improved following hospitalization. The temperature subsided after approximately four days. On the eleventh hospital day the patient developed an acute respiratory distress. He sat up in bed and gasped for breath. Moist râles rapidly developed throughout his chest. Respiration grew progressively more shallow and he died four hours following the onset of this respiratory distress.

The red blood cell count, the white cell count and the hemoglobin were normal. The Kahn test was negative. The autopsy was performed three hours following death.

The only pathological changes observed in this case were associated with the heart. It weighed 450 Gm. A fibrinous hemorrhagic exudate was present over the epicardium. It was most extensive in the area of the left ventricle. The myocardium in the left ventricle and the greater portion of the interventricular

septum was necrotic. The necrosis occurred in that portion of the cardiac muscle supplied by the anterior descending branch of the left coronary artery. Only a few inflammatory cells infiltrated the necrotic myocardium. An extensive fibrosis was present throughout the area of the myocardial necrosis.

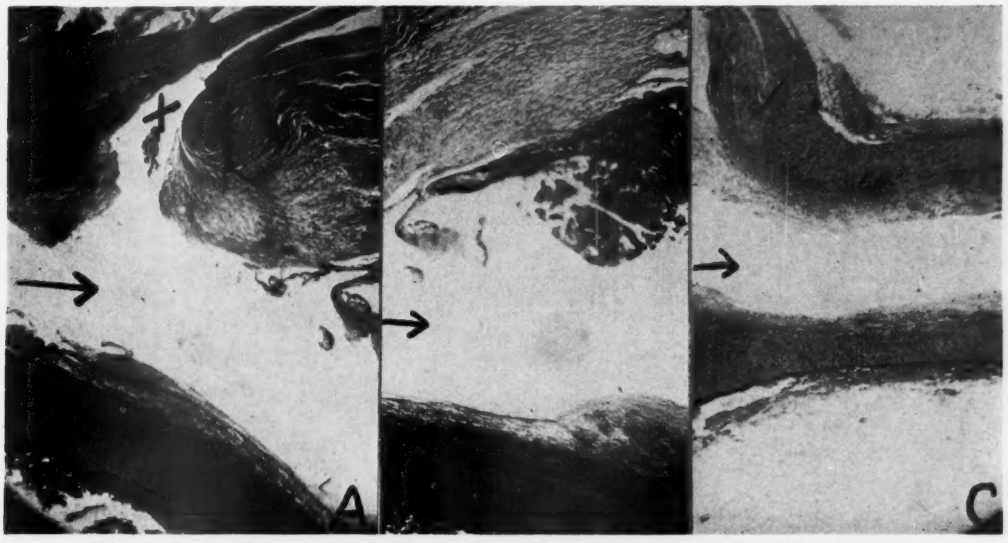


FIG. 3. These three microphotographs are from the aneurysm on the right coronary artery located proximal to the aorta. The arrows indicate the direction of the flow of the blood. A, the lumen of the small arterial branch is indicated by x. The margin of the aneurysm is located in the acute angle formed by this vessel. The intima is markedly hypertrophied and the muscularis stops at the margin of this aneurysm. B, the wall of the aneurysm is formed primarily by hyaline connective tissue. A thrombus is attached to the intima. C, note the thick intima and the abrupt interruption of the muscularis at the distal margin of the aneurysm. The opposite wall is normal.

An aneurysm 2.0 by 1.5 cm. was present on the left coronary artery at a point 1.5 cm. distal to its orifice. (Figs. 1A and 2.) This aneurysm was located at the point of bifurcation of the anterior descending and circumflex branch. The muscularis of the vessel wall rapidly decreased in width as the wall of the aneurysm was approached. The intima became greatly thickened. The internal and external lamellae gradually decreased in amount as they extended into the wall of the aneurysm. The adventitia was increased in amount. In some areas the wall was formed by hyaline connective tissue which was continuous with the intima on one side and the adventitia on the other. Few round cells infiltrated the adventitia. An atherosclerotic process occurred along the inner surface of this aneurysm.

The orifice of the circumflex branch is shown at the proximal end of the aneurysm inferior to the opening of the left coronary artery. (Fig. 1.) It was grossly normal for a distance of 1.5 cm. at which point it dilated to a diameter of 1.0 cm. (Fig. 2.) This annular aneurysm extended along the artery for approximately 2.0 cm. A small artery had its origin in this aneurysmal dilatation. The lumen of this latter vessel was partially occluded by a sclerotic plaque.

The anterior descending branch of the left coronary artery originated from the distal part of the aneurysm and extended along the anterior longitudinal sulcus. A recent thrombus occluded this vessel at a point immediately distal to the aneurysm.

The right coronary artery was examined by removing the adjacent fat before the lumen of the vessel was opened. An aneurysm was present on this artery at a point 0.5 cm. distal to the wall of the aorta. This aneurysm was 1.0 cm. in diameter and was located at the apex of the acute angle formed by a large branch leaving the right coronary artery. (Fig. 1B and 2.) A second aneurysm was present on the right coronary 5.0 cm. from the aorta. This annular aneurysmal sac was 1.0 cm. in diameter and involved 2.0 cm. of the lumen of the artery. A small branch left the coronary artery in this aneurysm. (Fig. 2.) Serial sections were made from the two aneurysms on the right coronary artery. Some of the sections were

stained with hematoxylin and eosin while others were stained to demonstrate the elastic tissue.

intima became markedly thickened in the wall of the vessel on both sides of the aneurysm (Fig. 4B.) The muscularis either completely

FIG. 4. The annular aneurysm located on the right coronary artery. A, the wall is formed by hyaline connective tissue and irregular and fragmented portions of muscularis. B, the wall of the coronary artery is markedly distorted at the margin of the annular swelling. The intima is hypertrophied and the muscularis is fragmented.

Histological studies of the aneurysm located at the bifurcation of the vessels on the right coronary showed a marked alteration in the intima, media and adventitia at the point where the sac began. The intima was tremendously thickened. (Fig. 3C.) The wall of the sac was formed primarily by hyaline connective tissue. The internal elastic membrane disappeared at the border of the sac. (Fig. 3A.) The muscular coat likewise almost completely disappeared at the border of the sac, only a small amount being present in the wall. (Fig. 3B.) There was only a moderate amount of adventitia over the wall of the sac. An occasional round cell was present in the wall. A thrombus was present in the lumen of this aneurysm. (Fig. 3B.) The base of this thrombus was organized. The vessel wall opposite to the aneurysmal dilatation was normal except for the presence of a small amount of atherosclerosis. (Fig. 3B.)

The histological changes in the aneurysmal dilatation on the right coronary located distal to that described above were quite different to those previously described. The intima, media, and adventitia were normal until they approached the aneurysmal dilatation. The stopped or became markedly decreased at the margin of the dilatation. The internal and external lamellae also either stopped here or they became markedly fragmented. The wall of the aneurysm was composed of hyaline connective tissue with areas of calcification. Portions of the fragmented and greatly distorted muscularis were present in some areas of the wall. (Fig. 4A.) There was a moderate amount of adventitia in the wall. Few round cells infiltrated this portion of the aneurysm. As far as we could determine from our examination there were no vessels leaving the aneurysmal dilation at the point where the muscularis was so distorted.

The orifice of each of the coronary arteries was normal. The aortic valve showed only a few sclerotic plaques. There was essentially no atherosclerosis in the aorta. All the valves of the heart were normal. The cavities were moderately dilated. There was congestion of the viscera and a bilateral hydrothorax (right 1,400 cc. and left 900 cc.).

Anatomical diagnosis: multiple aneurysms on the right and left coronary artery (congenital); recent thrombosis of the descending branch of the left coronary artery; acute

myocardial infarction of the left ventricle; acute fibrinous pericarditis; dilatation of the right and left ventricular cavities; chronic passive congestion of viscera; pleural effusion, bilateral (left 900 cc., right 1,400 cc.).

Petechiae in the mucosa of the intestinal tract; a minimum amount of coronary sclerosis; small calcified nodules in the lungs; diverticulae in the colon; fibrosis of the myocardium in the left ventricle (old infarction) and laceration of the skin over right foot.

REMARKS

Two of the four aneurysms occurring on the coronary arteries in this case are located at either the point of bifurcation or at the point where a branch leaves the parent vessel. Defects in the coronary arteries in such locations have been demonstrated by Forbus.[18] We, likewise, have found a similar defect in the left coronary artery in a boy fourteen years of age. (Fig. 5.) Aneurysms occurring at the point of bifurcation of the cerebral vessels have been attributed to a similar defect. It appears likely that two of the aneurysms in our case may have developed on account of a medial defect which may be explained on a congenital basis.

The two aneurysms which occurred as an annular dilatation on the anterior descending branch of the left coronary and on the right coronary arteries apparently represent a different type of development than those occurring at the bifurcation of the coronaries. Only one of these two annular aneurysms were studied histologically. This aneurysm differed from those occurring at the point of bifurcation of the coronary artery in that the intima and the muscularis in the wall of each side of the vessel was distorted. There was some arteriosclerosis in the wall of the artery at the point of this aneurysm. In our opinion one could not say conclusively that this aneurysm developed as a result of the arteriosclerosis. The absence of an inflammatory reaction in the wall of the artery would not be conclusive evidence that this annular aneurysm did not follow an inflammatory process; however, one could not conclude that it did develop secondarily to an inflammatory reaction. Congenital defects in the wall of arteries have been observed by several investigators and their observations have been discussed by Forbus.[18] From this discussion it appears likely that the two annular aneurysms occurring on the right coronary and the anterior descending branch of the left coronary artery may have resulted from a congenital defect in the walls of these vessels.

Fig. 5. Point of bifurcation of left coronary artery in a boy fourteen years of age. Observe the failure of fusion of the muscularis of the two vessels at the acute angle. The adventitia and the intima are continuous. The intima is thicker than normal. Congenital defects such as this may be the etiological process in the development of aneurysms.

The frequency in which aneurysms develop at the points of division of the coronary arteries has been emphasized by Pacher and Wechsler.[2] These investigators observed that when aneurysms are single they occur within the first inch of the coronary vessels. The aneurysms described by Vogelsang[19] and Monahor[13] appear to be identical in location with two in our case. Both investigators consider that their case developed on the bases of syphilis.

There is some atherosclerosis in the coronary arteries in our case. There is neither a history nor serological nor

pathological evidence of syphilis in this patient. The histological changes in the coronary vessels and the wall of the aneurysm do not indicate that a previous inflammatory process might have been the bases for the development of these aneurysms.

It is obvious from a review of the literature that aneurysms occurring on the coronary arteries are rare. Many of the reported cases result from embolic and mycotic phenomena.[15,17] Some of the aneurysms apparently developed in association with rheumatic arteritis,[12] while others are associated with arteriosclerosis[6] and syphilis.[3] It is suggested that some of these aneurysms in previous publications may have developed on the bases of a congenital defect in the media of the artery.[13,18]

The infrequency in which a medial defect occurs at the bifurcation of the coronary arteries is indicated by the observations of Forbus.[18] Furthermore, it must be remembered that aneurysms do not always develop when there is present a muscular defect in the cerebral, mesenteric, and coronary arteries. The pathological data at this time apparently justify the conclusion that aneurysms may develop on the coronary arteries either at the point of bifurcation or in the angle formed by a branch leaving the parent vessel as a result of a congenital defect in the development of the media of the arteries. It has been suggested by Forbus[18] that this defect results from the failure of the media to fuse in the wall of the two branches. The wall of the artery, therefore, is potentially weaker at the bifurcation than elsewhere. We are not familiar with the frequency in which congenital defects occur in the wall of arteries at points other than at the bifurcations, however, it would appear that the development of aneurysms in such locations is infrequent.

SUMMARY

The fifty-second case of an aneurysm occurring on the coronary artery is reported. It is suggested that the aneurysms located at the bifurcation of the major branches of the coronary arteries develop as a result of a congenital defect which occurs in the media of the artery.

The cases of aneurysms occurring on the coronary arteries previously reported are briefly reviewed. It appears that some of these may have developed as a result of a defect at the point of bifurcation of the coronary vessels. The location of some of these aneurysms in regard to the aorta and the branches of the coronaries is similar to that in our case.

Etiological agents other than congenital defects may produce aneurysms in the coronary arteries.

REFERENCES

1. Bougon. *Biblioth. Med.*, 37: 183, 1812. (Reference from Packard and Wechsler[2].)
2. Packard, Maurice and Wechsler, H. F. Aneurysm of the coronary arteries. *Arch. Int. Med.*, 43: 1–14, 1929.
3. Snyder, George A. C. and Hunter, Warren C. Syphilitic aneurysm of left coronary artery with concurrent aneurysm of a sinus of valsalva, and an additional case of valsalva aneurysm alone. *Am. J. Path.*, 10: 757–772, 1934.
4. Harris, Paul N. Aneurysmal dilatation of the cardiac coronary arteries—review of the literature and report of a case. *Am. J. Path.*, 13: 89–98, 1937.
5. Abbott, Maude E. and Chase, W. H. Bicuspid aortic valve of congenital origin with associated defect of the interventricular septum and streptococcal endocarditis with mycotic aneurysm of left coronary artery and extensive recent infarction of myocardium of left ventricle. *J. Tech. Meth. & Bull. Inst'l. Asso. Med. Museums*, 12: 171, 1929.
6. Pretty, H. C. Dissecting aneurysm of coronary artery in woman aged 42; rupture. *Brit. M. J.*, 1: 667, 1931.
7. Nagayo, M. and Takahashi, H. Aneurysma serpentinum der linken koron arterie. *Tr. Jap. Path. Soc.*, 22: 583–590, 1932.
8. Domenishini, P. Aneurisma e trombosi nel ramo discendente dell' arteria coronaria sinistra. *Cuore e circolaz.*, 18: 244–251, 1934.
9. Seydel, F. C. Uber die leutische Erkrankung der Herzkranzgefasse mit einem Fall eines syphilistischen aneurysmas an dem vorderen absteigenden ast der linken. *Ztschr. f. Kreislaufforsch.*, 27: 265–271, 1935.
10. Eliasoph, B. Aneurysm and thrombosis of left coronary artery with aneurysm of left ventricle and interventricular septum. *J. Mt. Sinai Hosp.*, 2: 26–29, 1935.

11. SCHUSTER, NORAH H. Aneurysm of sinus of Valsalva involving coronary orifice. *Lancet*, 1: 507–508, 1937.
12. RAE, M. V. Coronary aneurysms with thrombosis in rheumatic carditis; unusual occurrence accompanied by hyperleukocytosis in child. *Arch. Path.*, 24: 369–376, 1937.
13. MONOHER, K. O. An aneurysm of a coronary artery. *Arch. Path.*, 26: 1131–1134, 1938.
14. CHIARI, H. Zur Kenntnis der aneurysmen der Kranzschlagadern des Herzens. *Wien. klin. Wchnschr.*, 51: 977–979, 1938.
15. DE NAVASQUEZ. The incidence and pathogenisis of myocardial lesions in subacute bacterial endocarditis. *J. Path. & Bact.*, 49: 33–38, 1939.
16. WESTERLUND, E. Coronary occlusion after carbon monoxide intoxication followed by aneurysm. *Ugesk f. læger*, 103: 1263–65, 1941.
17. CHIPPS, H. D. Aneurysm of coronary artery. *Am. J. M. Sc.*, 204: 246–250, 1942.
18. FORBUS, WILEY D. On the origin of miliary aneurysms of the superficial cerebral arteries. *Johns Hopkins Hosp. Bull.*, 47: 239–284, 1930.
19. VOGELSANG, T. M. Aneurysm of the coronary artery and gummatous myocarditis. *Urol. & Cutan. Rev.*, 34: 62, 1930.

SCATTERED obstetrical and gynaecological references are found in the text of the uroscopist Gualterus Agulinus and that of Petrus Hispanus, who dealt with amulets and magic formulae and warned against the menstruating woman. Gilbertus Anglicus advocated perineal protection and repair in delivery. Among the causes of prolapse, he included complete perineal laceration. Gilbertus suggested the novel method of using leeches at the vulva in cases of lost virginity to simulate defloration bleeding, adding that the minute scars found at the sucking points would be easily obliterated by the trauma of coitus and bleeding would follow.

SUTURE MATERIALS

LOUIS E. MAHONEY, M.D.
Chief of Staff, St. John's Hospital
SANTA MONICA, CALIFORNIA

DURING the past few years there has been a vast amount of excellent work done in many laboratories on the subject of wound healing and the type of sutures which will facilitate the best end results. Until about ten years ago, it was generally believed, although there were a few serious students who clung to the use of silk, that catgut was the ideal suture material. When reports of wound disruptions, the frequency of stitch abscesses, wound infections, hematomas, etc., began to fill the literature it became evident that there was ample room for great improvement. Since that time manufacturers, as a result of these disclosures and the pressure it brought upon them, have evolved finer sizes of catgut and incomparably more efficient methods of sterilization. It is, undoubtedly, true that more and better types of all varieties of suture materials are being produced at present than at any time in our history. However, general knowledge of this progress has not penetrated into the surgical consciousness of many of our confreres and no material has yet emerged that fills every need. As a logical consequence, there is good reason for a periodical review of the subject, for a critical examination of widely held views, for discarding notions which have been proved to be fallacious and for an earnest attempt to improve our results by intelligent application of recently acquired information. It is to those surgeons who are not entirely satisfied with their present results that this essay is addressed. As a preliminary to a more detailed discussion of the subject, a brief restatement of certain basic surgical principles might not be out of order.

First, the only purpose of any suture, absorbable or non-absorbable, is to hold tissues in approximation until such time as they are able to reunite.

Second, it is quite obvious that the smallest amount of any material should be used that will safely accomplish this result.

Third, the holding power of tissues for sutures (tissue tension) should always be kept in mind. Roughly speaking, this figure is in the neighborhood of three pounds, which is approximately the tensile strength of 0 or 00 catgut or No. 1 silk. There is seldom any necessity for using larger sizes, as they either cause complications (stitch abscess, allergic reactions, etc.,) or defeat their own intended purposes by cutting through tissues.

Suture materials are divided into two classes: absorbable i.e., catgut, non-absorbable, i.e., silk, nylon, cotton, linen, plastigut, stainless steel wire, equisetene, etc.

The most important varieties of catgut are plain or chromicized. Plain catgut is employed where quick healing takes place and where rapid absorption is desired, for instance in serosa and mucosa covered surfaces, and for the ligation of small blood vessels. Chromic catgut should be selected for approximating fascial and connective layers and for tying the larger blood vessels. The thrombus which immediately forms in a small blood vessel may be depended upon for hemostasis, but in the larger arteries or veins the process of fibroplasia and connective tissue formation is the important factor of safety and it is, therefore, desirable to ligate these structures with catgut which is slowly absorbed.

It should also be pointed out that certain tissues, i.e., skin, subcutaneous fat, muscle and mucous membranes do not tolerate any sort of catgut very well. The skin being

filled with hair follicles and sebaceous glands which almost always contain bacteria is quite prone to infection. The subcutaneous fat has but little holding power and probably should not be sutured unless it is necessary to obliterate "dead spaces," in which event the very finest sizes 000 or 0000 should be utilized. Muscles are in much the same category as subcutaneous fat, and when they must be drawn together, it is much better to approximate very carefully their fascial envelopes with interrupted sutures of fine chrome gut. Mucous membranes are likewise very prone to become infected, or to be torn by the larger sizes of sutures, and for this reason the very finest catgut (0000 or 00000) threaded on small needles will give the quickest and strongest type of union.

All catgut sutures, whether plain or chromic, are foreign bodies and as such excite an inflammatory tissue reaction in order that they may be absorbed. Many interesting studies have shown that the degree of this reaction depends almost entirely upon the amount of catgut used. A No. 2 chromic doubled running suture will cause a great deal more exudation, lymphocytic and leucocytic invasion, and more firbroplastic proliferation than a No. 00 interrupted stitch. Literally, millions of cells are destroyed in the process of digestion and absorption and naturally the more catgut with triple knots, etc., inserted into the wound, the more body cells must die in the process of removing the foreign body. That is the prime reason for the reddened, inflamed appearance of wounds sutured with large amounts of catgut. The surgeon should always remember that his gentlest efforts cannot fail to do tremendous damage to millions of delicate living cells and he should develop a technic that will minimize this harmful effect as much as possible. The idea held by a good many individuals that large amounts of suture materials protect against hemorrhage and give greater strength to a recent wound is entirely fallacious as digestion and absorption of excessive amounts of foreign bodies can only cause considerable exudation, weaken the thread strength of the suture and greatly slow the healing process. The tissues which should be producing fibroblasts preliminary to the laying down of completed connective tissue are kept busy getting rid of the catgut. There is a vast distinction between sewing up a piece of cloth and uniting living, breathing delicate filaments of cells.

In this connection a word about the best manner in which to secure a good strong wound, as repeatedly demonstrated in experimental surgery, might not be amiss. Briefly, fascia or connective tissue layers should be approximated by sutures not larger than No. 0 or 00 chromic or No. 1 silk and interrupted stitches should be placed at right angles to the direction of the fibers of the supporting structures. If stitches are inserted along the grain of the tissues, they are likely to tear out. If sutures larger or stronger than the holding power of the connective tissue layers are used, they will either cause an unnecessary amount of exudative reaction, or tear through and thus defeat their intended purpose. Long experience of a great many surgeons has shown that about 1 cm. (one-third of an inch) is the proper distance between sutures. Many ventral herniae owe their origin to a continuous suture of No. 1 or 2 chromic catgut, perhaps doubled, which lost its thread strength on the third or fourth day postoperatively and permitted the posterior sheath of the rectus to open widely when the patient retched or coughed. The small amount of time saved in employing a continuous stitch rather than interrupted sutures is hardly worth while in the light of the ultimate results achieved.

Non-absorbable sutures are of various sorts, silk, nylon, cotton, equisetene, linen, plastigut, stainless steel, etc. In general, they do not cause as much irritation to the tissues as does catgut and the healing which follows their use is often spoken of as "dry healing" in contrast to the exudative reaction of all catgut which is

popularly termed "wet healing." The ideal material has not yet been developed and those listed above differ among themselves in the degree of tissue irritation produced and in the mechanical features incident to their employment. Cotton was introduced several years ago and is probably an excellent material. Stainless steel wire is becoming popular in some localities. Had either cotton or stainless steel been used originally they might be the choice of most surgeons at the present time, but it so happens that silk was first introduced by Kocher and afterward used in America by Halstedt, so it remains the most important of the non-absorbable materials. Any remarks concerning the use of silk may with perfect propriety be applied to the other very excellent substitutes.

The general surgical principles embodied in the use of suture materials should properly be the same regardless of the type involved. However, there has grown up in the United States two schools of thought on the matter, and two resulting technics which differ in many important details. In general, it may be said that surgeons who employ silk are likely to understand better the newer discoveries in wound healing, or at least to put them into daily practice, and to cultivate a greater respect for tissues than those who use absorbable material. The knowledge that they are inserting into the tissues something which will remain there for years may predispose to caution. At any rate surgeons who employ silk take a little more time to perform operations, use smaller sizes of sutures, smaller instruments, take tiny bites of tissue, are perhaps slightly more careful about hemostasis, employ more interrupted sutures and cut the ends of knots more closely. Issue might be taken with these rather broad statements, but any individual who has observed a great many American surgeons work in different parts of this country will probably agree that, for the most part at least, they are quite true.

Silk has certain inherent advantages. It can be boiled repeatedly without impairing thread strength to a marked degree and this obviously means better sterilization. The excellent work done in the standardization and sterilization of catgut during the past few years has greatly improved the product but despite all this, the sterility of catgut does not compare in efficiency with that of silk. As mentioned in preceding paragraphs, silk does not produce the intense exudative and proliferative reaction of catgut and as a result the wound closed with this material will regain its strength more rapidly. In general, the silk wound will heal in two or three days less time than the one closed with catgut and will give a better and stronger scar. Owing to a combination of these favorable factors, there will be fewer wound infections or wound disruptions as has been well shown by numerous statistical reviews. From the mechanical standpoint, braided or twisted silk is not so likely to slip at the knot. When economy is considered, and it is a factor of interest to hospital administrators in this period of rising prices, the cost of silk is approximately one-fifth that of catgut.

One drawback to the universal employment of silk has been the lack of uniformity with respect to sizes among the various manufacturers. However, the recent action of the U. S. Pharmacopeia (12 Decennial Revision) in publishing standard nomenclature for size designations, permissible range of size variation and minimum tensile strength standards and correlating such specifications with similar tables previously released for catgut will have a very helpful effect. Up to the present time, surgeons who might occasionally use silk without a thorough knowledge of its tensile strength would unconsciously feel that the silk suture would need to be the same size as the catgut with which they were very familiar and might, for instance, ask for No. 5 silk when C. or No. 1 would better suit their purpose. When they failed to secure the results they had expected, they were inclined to blame

the suture material without carefully examining the other important factors involved.

There are some contraindications to the use of silk: It should not be inserted in any hollow viscus, i.e., the gallbladder, the urinary bladder, or to unite the mucosal layer of the stomach or small bowel. Concretions have formed on suture ends in hollow viscera. In the small bowel when anastomoses have been performed, small erosions and ulcers have been found at the site where the stitch perforated the mucous membrane. In this connection, it should be remembered that silk is not intended to be used as a continuous stitch as it strangulates tissue. A possible exception to this rule is in closure of the peritoneum where a running stitch does not appear to cause trouble. Likewise, it has been considered unwise to rely upon silk in infected wounds although Shambaugh and Dunphy, in 1937, very carefully investigated this problem and found no logical reason for this widely held opinion. In closing external wounds with silk it should be remembered that if the larger sizes are employed and there is any reason to suspect that the operative field is not reasonably free from harmful bacteria there is likelihood that some of the ligatures may slough through the skin at a later date. The small sinus which results is merely a minor annoyance to the patient and the surgeon and always heals as soon as the offending stitch has been extruded.

A practical consideration in the selection of suture material is that most hospitals and most nurses are trained in the use of catgut and quite familiar with its properties while they are not equally informed as to the advantages and disadvantages of the non-absorbable sutures. As a result, a certain amount of education and very careful supervision is required on the part of the surgeon who would employ unfamiliar materials. If he does not take the time and trouble to watch details, the ultimate result may be failure to secure the quick, firm healing he has been lead to expect.

The purpose of this discussion is not to attempt to convert the surgeon who employs catgut to the use of non-absorbable materials but rather to induce him to reconsider his technic in the light of results achieved by users of silk. It has been repeatedly and clearly demonstrated that wound healing can be accelerated and the numbers of infections diminished by use of smaller sizes of catgut, careful hemostasis, interrupted sutures, avoidance of mass ligation of large pieces of tissue, etc. General adoption of these safe and sane surgical principles may enable users of catgut to approximate the excellent results which have long been commonplace to surgeons who use silk.

Many men are too busy in their ordinary tasks and with the heavy responsibilities thrust upon them in everyday life to give much thought to such matters but if a perusal of this article will cause them to review their knowledge of wound healing and thus improve their operative technic, it will give added luster to the honorable profession of which we have the good fortune to be members.

SIGNIFICANCE OF SCHWANNOMAS AS A FACTOR IN OBSCURE CASES OF APPENDICITIS*

WILLIAM R. LAIRD, M.D. AND LEWIS E. NOLAN, M.D.
MONTGOMERY, WEST VIRGINIA

APPARENT discrepances between the clinical and anatomicopathologic findings in appendicitis are only too familiar to both surgeons and pathologists. Not infrequently a vermiform appendix is called normal by the surgical pathologist after a cursory examination of one or two sections fails to disclose infiltration of the wall with exudative cells. Such a practice often proves embarrassing to the surgeon, and is a source of controversy between surgeons and pathologists. In other cases the specimen is described as an "interval appendix" or a "chronic appendix" indicating failure to discover the underlying disorder.

The authors are of the opinion that gross and microscopic study of the removed appendix should include a search for such factors as examination of the contents of the appendix for evidence of catarrhal inflammation and intestinal parasites, e.g., oxyuris vermicularis; anomalies of the valve of Gerlach; interference with the circulation from ptosis, overmobility of the cecum, unusual external pressure; fibrosis with stenosis; foreign bodies, fecoliths; carcinoids and other neoplasms; evidence of peri-appendicitis; evidence of both infection and obstruction, acute kinking by a band or fold; endometrial implantation; mucocele, and the presence of schwannomas often described as neuromas or neurinomas.

The terminations open to inflammation of the appendix are resolution with return to normal; tissue destruction, suppuration, gangrene and rupture; and finally healing with formation of cicatrices. The entire mucosa may be converted to a fibrous mass with obliterations of the lumen. The latter condition is often mistakenly diagnosed as chronic appendicitis. The fallacy of this term lies in the fact that inflammation is a local reaction to an irritant and it, therefore, follows that inflammation is a process and not a state. Fibrosis of the appendix must either be regarded as an atrophic retrogressive process associated with advance in years, or as a result of a previous inflammation and not the indication of an existing inflammatory process. Corelation of pathological findings and the clinical course is of inestimable value in the solution of this controversial question.

Appendiceal fibrosis or obliteration of the lumen is well known to both surgeons and pathologists; however, it was not until the work of Maresch[1] and Masson,[2] in 1921, that neurogenic appendicitis as an entity, was considered. Masson observed that in many adults with history of previous attacks of appendicitis, there was narrowing of the lumen, great diminution or absence of lymph follicles, thickening of the submucosa, hypertrophy of muscle and hyperplasia of the nerves of Neissner's and Auerback's plexuses.

The neuromas arise from the periglandular nerve plexus in the mucous membrane. Argentaffin cells have been demonstrated actually inside the nerve fibers. These cells apparently arise from the epithelium that lines the bottom of the glands of Lieberkuhn by a process of budding and then ingrate into the nerves. The excessive growth in all likelihood is the result of previous inflammation with regeneration of nerves following the process of destruction which probably occurs as the result of an inflammation not severe enough to cause destruction of the appen-

* From the Departments of Surgery and Surgical Pathology of the Laird Memorial Hospital.

dix. The nerves containing the cells grow and form the neuromas. The specific cells of this tumor are connected in a syncytium like Schwann cells and possess elongated nuclei and are grouped in networks, bundles and palisades. The palisades consist of oval nuclei aligned in the same transverse plane and may be compared in appearance to the staves of a barrel. In keeping with the origin of the cells from the sheath of Schwann the term Schwannoma is preferable to the terms neuroma and neurinoma which suggest tumors made up of nerve cells or perineural fibromas.

Hosoi,[3] in 1933, studied 195 cases of appendicular neuromas based on 344 consecutive vermiform appendices removed at operation showing no gross or microscopic evidence of acute or subacute inflammation. In this series there were 48 per cent with partially or completely obliterated lumen and of these 82 per cent contained axial neuromas proved microscopically. He described 8.2 per cent as having cramp-like and agonizingly severe pain, in 19 per cent acute but not such extreme pain, in 7.7 per cent definite pain but not acute, in 10.3 per cent dull ache in the right lower quadrant, and in 3.1 per cent discomfort in the right lower quadrant or epigastric distress. Fein, Hanan and Seidler,[4] in 1939, listed 202 neuromas among 600 appendices with some degree of obliteration. There was associated acute suppurative appendicitis in 12.1 per cent and subacute appendicitis in eighty-two cases of neuromas of the non-obliterative type. There were 140 or 64.3 per cent neuromatous lesions of the obliterative type which is in agreement with the figures of Hosoi and Masson.

This investigation regarding the significance of Schwannomas of the vermiform appendix is based on a clinical and pathologic study of fourteen cases during the past five years at the Laird Memorial Hospital in which neuromatous lesions were demonstrated in the appendices by histopathological examination.

Age and Sex. Eight patients were females and six males. The ages were fifteen, twenty, twenty-one, twenty-two, twenty-three, twenty-four, twenty-eight, thirty-one, thirty-two, thirty-three, thirty-three, forty-three and forty-four years, respectively. The youngest patient was fifteen and the oldest forty-four years of age. The average age was twenty-seven years.

Character of Pain. Eleven of the patients complained on admission, of intermittent, cramp-like recurrent attacks of sharp, colicky pain in the right lower quadrant. This was often sufficiently severe to cause them to double up. Two complained of generalized abdominal discomfort, and one of posterior lumbar and low abdominal pain.

Nausea and Vomiting. Ten of the group had nausea followed by vomiting. Four complained of neither nausea nor vomiting.

Physical Examination. Two patients were notably apprehensive and had an anxious facies. There was tenderness on palpation over the right lower quadrant in all fourteen cases. One patient had board-like rigidity of the entire abdomen and one had tenderness on palpation over the left lower quadrant as well as the right. Eight had a slight increase in temperature of 1°F. or less. The highest oral temperature recorded in the series was 99.6°F. The pulse rate was over 90 in only three cases, with rates of 96, 96 and 120, respectively. Three also had a respiratory rate of over 24. Recording of the blood pressure disclosed no systolic readings over 150 and but two diastolic measurements over 90.

Clinical Laboratory. Urinalysis, leucocyte count, hemoglobin estimation, Kahn test, and sedimentation rates according to the method of Westergren, were performed in all fourteen cases. In only four patients was the total leucocyte count over 10,000. The highest leucocyte count was 14,000 in the patient who had board-like rigidity of the abdomen. The differential leucocyte count in this case was 87 per cent polymorphonuclears, 2 per cent monocytes and 11 per cent lymphocytes. Differential leucocyte count disclosed four patients

with over 75 per cent polymorphonuclears. One patient had 9 per cent monocytes and another had 4 per cent eosinophiles. The sedimentation rate was increased in five patients. The Kahn precipitation test for syphilis was negative in all cases.

Postoperative Course. The postoperative course was uneventful in thirteen cases. All of these patients were relieved, and follow-up examinations disclosed no complaints or evidence of disease. The woman who had complained on admission of posterior lumbar and low abdominal pain, continued these complaints at subsequent check-up examinations. Thorough physical examination did not disclose an anatomic basis for complaint.

Surgical Pathology. Histopathologic study of the removed appendices utilizing hematoxylin-eosin and Masson's stain, disclosed plexiform and axial neuromatous lesions in all fourteen appendices. In one of the cases an axial neuroma was observed and also infiltration of the subserosa and tunica muscularis with aggregations of small polyblasts and polymorphonuclears.

COMMENT

Neurogenic appendicitis is very difficult and at times impossible to differentiate preoperatively from early obstructive appendicitis. The temperature, pulse and respiration remain normal or only slightly elevated in the case of uncomplicated neuromatous lesions of the appendix. The leucocyte count and sedimentation rates tend to be within normal limits. The acute pain of neurogenic appendicitis tends to be colicky, cramp-like and momentary or intermittent, followed by a dull ache.

SUMMARY

1. The pathological changes of Schwannoma of the vermiform appendix is presented with an evaluation of its significance in neurogenic appendicitis.

2. Fourteen cases are described, of patients complaining of lower right quadrant pain, thirteen of whom were relieved by appendectomy with histopathologic demonstration of axial neuroma or Schwannoma in the fourteen cases.

3. Patients with Schwannomas of the vermiform appendix may have co-existing acute appendicitis and vice versa.

4. Neurogenic appendicitis must be considered in patients complaining of attacks of intermittent, colicky, cramp-like lower right quadrant pain and having normal temperature, pulse and respiratory rates, and with hematological survey within normal limits.

REFERENCES

1. Maresch, R. Ueber das Vorkommen neuromartiger Bildringen in obliterierten Wurmfortsatzen. *Wien. klin. Wchnschr.*, 34: 181, 1921.
2. Masson, P. *Am. J. Path.*, 4: 181, 1928.
3. Hosoi, K. Neurogenic appendicitis. *Am. J. Surg.*, 22: 428–446, 1933.
4. Fein, M. J., Hanan, J. T. and Seidler, V. B. Plexiform neuroma of appendix. *Am. J. Surg.*, 39: 27–33, 1938.

AN EVALUATION OF THE McNEALY CECOSTOMY*

JOHN WILLIAM HOWSER, M.D.
Associate Attending Surgeon, Cook County Hospital
CHICAGO, ILLINOIS

IN general, it would seem that the cecum is not the best site for the creation of a permanent colostomy. However, in certain instances the creation of a temporary cecostomy is life saving. The most common indication for such a procedure is in patients with a large bowel obstruction due to a tumor of the distal colon, in whom the intestinal canal cannot be decompressed by any of the usual methods of suction or irrigation.

In many instances there is intra-abdominal contamination at the time of formation of the cecostomy due to fecal spillage in performing the cecostomy. Peritonitis may occur and the mortality is high in such a case.

A large bowel obstruction seems to be less toxic than a small bowel obstruction. A period of ten to twelve hours' delay in opening the cecum is not in itself dangerous to the life of the patient. It would seem then, that the cecostomy advocated by McNealy,[1] in 1937, would fulfill the two obligations demanded in this type of procedure. First, it allows of no intra-abdominal spillage, and secondly, produces a vent for decompression.

The type of cecostomy described in the original article is as follows:

"Under local infiltration the cecum is exposed through a muscle splitting incision similar to that used for appendectomy. The anterior wall of the cecum is drawn gently through the incision and clamped along the anterior tenia with one or two curved forceps. No sutures are used anywhere in the operation. Between the serosa of the cecum and the anterior parietal peritoneum a strip of iodoform gauze is inserted to facilitate the formation of protective adhesions . . . in the usual cases the incision is packed open down to the peritoneum, and left undisturbed for twelve hours. A catheter may then be inserted."

It will be seen that there is no possibility of leakage into the abdomen in this method, because there are no sutures taken, and because the cecum is not opened in the free peritoneal cavity. The usual type of cecostomies, using the purse-string method of Stamm, or the buried tube method of Witzel, always allow contamination into the general peritoneal cavity no matter how carefully one packs off the field. Also, it is impossible to take "seromuscular" sutures in a thin distended, edematous cecum. Some must go into the lumen and allow further leakage.

There is no doubt that a cecostomy is a poor permanent type of colostomy. The contents of the right colon are liquid, the entire bowel current is not diverted, and the cecostomy will close if the distal obstruction is relieved. However, these very points make a cecostomy an ideal temporary vent for the relief of distal colon obstruction. The liquid contents tend to drain easily, the cecostomy will close spontaneously after the distal colon is either resected, or a permanent colostomy performed.

I have used this type of cecostomy eighteen times in the past year, to provide decompression in cases of large bowel acute mechanical obstruction, due to blockage of the distal colon. In all of these cases the distention was very marked, and was unrelieved by the usual intestinal suction and irrigation. Some of the patients were markedly obese. I have followed these cases throughout the course of the secondary procedures, or through postmortem

* From the Department of Surgery, Loyola University Medical School, and Cook County Hospital, Chicago.

examination if death occurred. In none of these cases was there any intra-abdominal contamination around the cecum, as evidenced by any form of peritonitis. Any leakage into the abdomen from the cecum in this type of a case usually will result in peritonitis and death. A procedure which markedly reduces this possibility is of value. From the evaluation of the cases cited above, I believe that the McNealy cecostomy completely obviates such a possibility.

There are a few added points which tend to make this a simple procedure, and attention to them will result in the formation of a safe and efficient temporary decompression vent.

The exact position of the cecum should be known before operation. This can be done by means of a flat film of the abdomen. The cecum is high in many instances, and because of mesenteric fixation, distends laterally rather than anteriorly. This has been pointed out by Hendricks.[2]

Because of this possibility it is well to make a rather high incision, about two inches higher than the usual McBurney incision.

It is well to defer placing the forceps on the anterior tenia of the cecum until after the iodoform gauze has been inserted between the parietal peritoneum and the cecum. If the cecum should tear at this point the iodoform would tend to protect contamination. I have never seen the cecum tear in placing these forceps, but in late cases it might be so very friable as to tear.

The handles of the forceps should be taped flat against the abdominal wall by the surgeon. Only he knows exactly how much tension has been necessary to pull the cecum out, and further tension in application of the tape to the forcep handles might result in tearing the structures.

At least six hours should be allowed to elapse before the cecum is opened. McNealy advocates twelve hours. The longer that one allows agglutination to occur, the less is the possibility of subsequent leakage.

In opening the cecum, it is well to insert a braided silk purse-string and a Pezzar catheter. However, in very obese persons so little cecum is delivered, that this is impossible. In these patients, simple opening is sufficient, although somewhat more messy to care for, than if a tube is used.

The curved forceps should not be removed. They will slough through and fall off of their own accord in about ten days. This will increase the available stoma and make the cecostomy function better.

SUMMARY

1. In the event of mechanical obstruction of the distal colon, the establishment of a temporary cecostomy may be used in case the conservative measures fail to decompress the intestinal canal.

2. In establishing such a cecostomy, the spillage of intestinal contents from the cecum into the general abdominal cavity is a serious problem and carries an increased mortality.

3. The McNealy type cecostomy establishes a vent proximal to the obstruction with no possibility of spillage at the time of such a procedure.

4. In a series of eighteen cases of large bowel obstruction, unrelieved by irrigation or suction, this type of cecostomy was utilized by the author.

5. In none of these cases was there any spillage into the abdominal cavity.

6. Several points which simplify the procedure are presented.

7. A cecostomy does not contraindicate nor make more difficult subsequent exploration of the left colon.

REFERENCES

1. McNealy, R. W. and Lichtenstein, M. E. *Am. J. Surg.*, 36: 3, 1937.
2. Hendricks, W. H. Personal communication, 1941.

INTRAVENOUS USE OF MORPHINE SULFATE

ROBERT O. PEARMAN, M.D.
Member of Staff, Mountain View Hospital, San Luis Sanitarium and San Luis Obispo General Hospital
SAN LUIS OBISPO, CALIFORNIA

ALTHOUGH morphine sulfate has been used therapeutically for about 140 years, too little attention has been given to the use of this valuable and time tested drug by the intravenous route. The feasibility of this method of administration was brought first to my attention in 1933 by a morphine addict who injected the drug into his veins or "shot the main line," as he expressed it in the jargon of his kind.

The intravenous route of administration is especially recommended for patients suffering severe pain because of the rapidity with which the analgesia is produced. I have used intravenous morphine to advantage and with no untoward effects in patients suffering from burns, fractures, biliary colics, renal colics, coronary thromboses, and cardiac decompensations. It is ideal for sensitive patients who are to be cystoscoped, bronchoscoped or gastroscoped. It is a very useful adjunct to regional or local anesthesia. One-sixth gr. (10 mg.) of morphine sulfate given intravenously will often produce sufficient analgesia to enable the surgeon to complete an operation on a patient, in whom the spinal anesthesia is beginning to wear off, without supplementary anesthesia.

Tuohy[2] states that usually an opiate is administered to patients as part of their preoperative medication, but that not infrequently the sedative effect is insufficient. In these cases the addition of 1/8 to 1/6 gr. (8 to 10 mg.) of morphine injected intravenously will frequently allay the patient's fears before intravenous anesthesia with pentothal sodium and materially decrease the amount of the anesthetic which must be administered.

In general, the administration of morphine to small children is best avoided because of the instability of their respiratory centers.

The rapidity with which analgesia is produced by subcutaneous morphine varies with the individual patient and the severity of the pain. I have found the length of time necessary to produce analgesia by the subcutaneous injection of morphine to vary from fifteen to thirty minutes. Another disadvantage is the fact that when morphine is given hypodermically, one must wait at least a half hour before determining if a further dose is necessary and then guess as to the size of the second dose.

Morphine sulfate given subcutaneously disappears from the blood stream in demonstrable amounts within twenty minutes after its appearance in it. Traces only remain in the blood stream of a cat two to ten minutes after intravenous administration. However, in dogs the drug remains thirty minutes in the blood stream after its intravenous injection.[3] Morphine sulfate is taken up by the tissues from the blood and gradually destroyed or eliminated. A variable proportion of the drug (about 1/5) is excreted in the urine, part free and part conjugated, while a much smaller amount is accounted for in the feces and other secretions of the body. The greater part is destroyed in the tissues, chiefly by the liver.

The effect of the drug after intravenous administration, in spite of being more pronounced at first, probably will last almost as long as the effect after subcutaneous administration.[4]

Varying sensations are described by patients who have received morphine sulfate intravenously. A few experience mild dizziness, tinnitus, tachycardia, and a feeling of warmth. Fainting with a quick recovery rarely occurs. Nausea and vomit-

ing are much less frequent following intravenous injection than following subcutaneous administration, probably because the vomiting center is depressed more rapidly by the intravenous use of morphine.[4]

A safe and simple method for the intravenous administration of morphine sulfate is as follows: Ampules of a sterile solution of morphine sulfate are preferable, but the tablet form may be used if ampules are not available. A 1 cc. ampule containing 1/6 or 1/4 grain (10 or 15 mg.) of morphine sulfate is aspirated into a 2 cc. syringe. A No. 20 gauge intravenous needle is attached. After venipuncture 1 cc. of blood is drawn into the syringe, and the syringe rotated gently to facilitate an even distribution of the blood in the solution. Three tenths of a cc. (.3 cc.) of the resulting solution is administered and one-half minute allowed to elapse. Any idiosyncrasy to the drug will be noted by that time if it is going to appear. The solution is then injected slowly (roughly, .2 cc. every five seconds) until the desired effect is obtained. No more of the drug should be injected than the amount necessary to obtain the result one wants. After complete relief of pain is obtained a small dose, 1/8 gr. (8 mg.), may be given hypodermically, if needed, to maintain the effect. Naturally, more of the drug will be required by patients in the throes of agonizing pain. However, it is not considered safe to give more than 1/4 gr. (15 mg.) of morphine intravenously at any one time. Should relief of the pain not be brought about by the first injection, it is safe, after an interval of ten minutes, to give a further injection, 1/8 to 1/6 gr. (8 to 10 mg.), slowly until relief is experienced.

In cases in which the dose of intravenous morphine cannot be gauged by the relief of pain, the patient is asked to notify the physician if such symptoms as dizziness, weakness, drowsiness, warmth, numbness, tingling, neuralgic pain, or backache occur. If one of these symptoms occurs, the injection is stopped. As a rule, 1/8 to 1/6 gr. (8 to 10 mg.) of morphine sulfate may be given intravenously to an adult without fear of an untoward reaction.

SUMMARY

The intravenous use of morphine sulfate is advocated in certain cases because the desired full analgesic effect is obtained immediately from an accurately regulated and individualized dose of the drug.

REFERENCES

1. Lundy, John S. The relationship of preliminary medication to anesthesia. *J. Indiana State Med. Ass.*, 29: 363–364, 1936.
2. Tuohy, Edward B. Clinical use of intravenous anesthesia alone and in combination with other anesthetics. *J. South. Med. Ass.*, 34: 42–47, 1941.
3. Hatcher, R. A., and Gold, H. Fate of morphine. *J. Pharmacol. & Exper. Therap.*, 35: 257, 1925.
4. Betlach, C. J. The intravenous use of morphine sulfate for analgesia. *Proc. Staff Meet., Mayo Clin.*, 12: 733–735, 1937.

Case Reports

PRIMARY SARCOMA OF DUODENUM

RESECTION WITH HEAD OF PANCREAS BY ONE-STAGE WHIPPLE OPERATION

J. Dewey Bisgard, M.D. and R. M. Cochran, M.D.*
Assistant Professor of Surgery,
University of Nebraska College
of Medicine
OMAHA, NEBRASKA

PRIMARY neoplasms of the small bowel are infrequent, malignant ones comparatively rare and sarcomas of the duodenum very rare. In a series of 17,000 autopsied cases at Guy's Hospital, Brill found ten primary malignant tumors of the small intestine; four were carcinomas and six sarcomas. Only one of the sarcomas arose from the duodenum. Raiford found not a single case of sarcoma of the duodenum in 986 cases of neoplasms of the gastrointestinal tract. In his series there were eighty-eight tumors of the small intestine of which fifty were benign and thirty-eight malignant and only two were sarcomas. Of the eighty-eight tumors, twenty-one involved the duodenum, and of these seven were malignant, all carcinomas.

From a series of 1,456 postmortem examinations and 41,000 surgical specimens Medinger collected twenty-two primary malignant tumors of the small bowel; eight were sarcomas.

Feldman collected fifty-eight cases of sarcoma of the small intestine from 104,621 necropsy reports and of these two were located in the duodenum.

All proved primary sarcomas of the duodenum reported in the literature previous to 1935 were collected by Prey, Foster and Dennis. They were able to assemble only sixty-one authentic cases and reported one of their own. They found several additional cases which probably belonged in the series but which could not be included because the reports were indefinite in respect to the location or primary nature of the tumors. Their report revealed a large predominence of lymphosarcomas. There was essentially an equal numerical distribution of the other cell types, spindle cell or fibrosarcomas, myosarcomas, melanosarcomas and myxosarcomas. Although these tumors frequently attain considerable size, they do not as a rule cause obstruction of either the duodenum or common bile duct. They usually cause much pain, anorrhexia and a rapid loss of weight and strength. Necrosis within the tumor is common and not infrequently this results in hemorrhage or in perforation of the wall of the duodenum with fistula formation.

The occasional relatively benign myosarcoma can often be excised without sacrificing the duodenum. The other types of sarcomas are usually too diffusely disseminated for surgical extirpation. On a rare occasion, however, there may be sufficient circumscription of the tumor to warrant radical excision of the duodenum. This is also true of the still rarer inflammatory granulomas of the duodenum. What appeared to be an indication of this kind led to resection of the duodenum in the case which we are reporting. This patient was explored with the erroneous pre-

* Dr. Cochran is now a Captain in the Army Medical Corps.

operative diagnosis of cholecystoduodenal or choledochoduodenal fistula. Finding the wall of the first and second portions of the duodenum much thickened by what appeared to be either inflammatory or neoplastic infiltration, a biopsy was taken and examined immediately in frozen section. Because the pathologist made a provisional diagnosis from this examination of chronic inflammation and because the pathological process appeared to be confined entirely to the duodenum, the first and second portions of the duodenum and the adjacent portion of the head of the pancreas were excised. The operation was performed in one stage; otherwise it was essentially the operation described by Whipple, Parsons and Mullins in 1935.

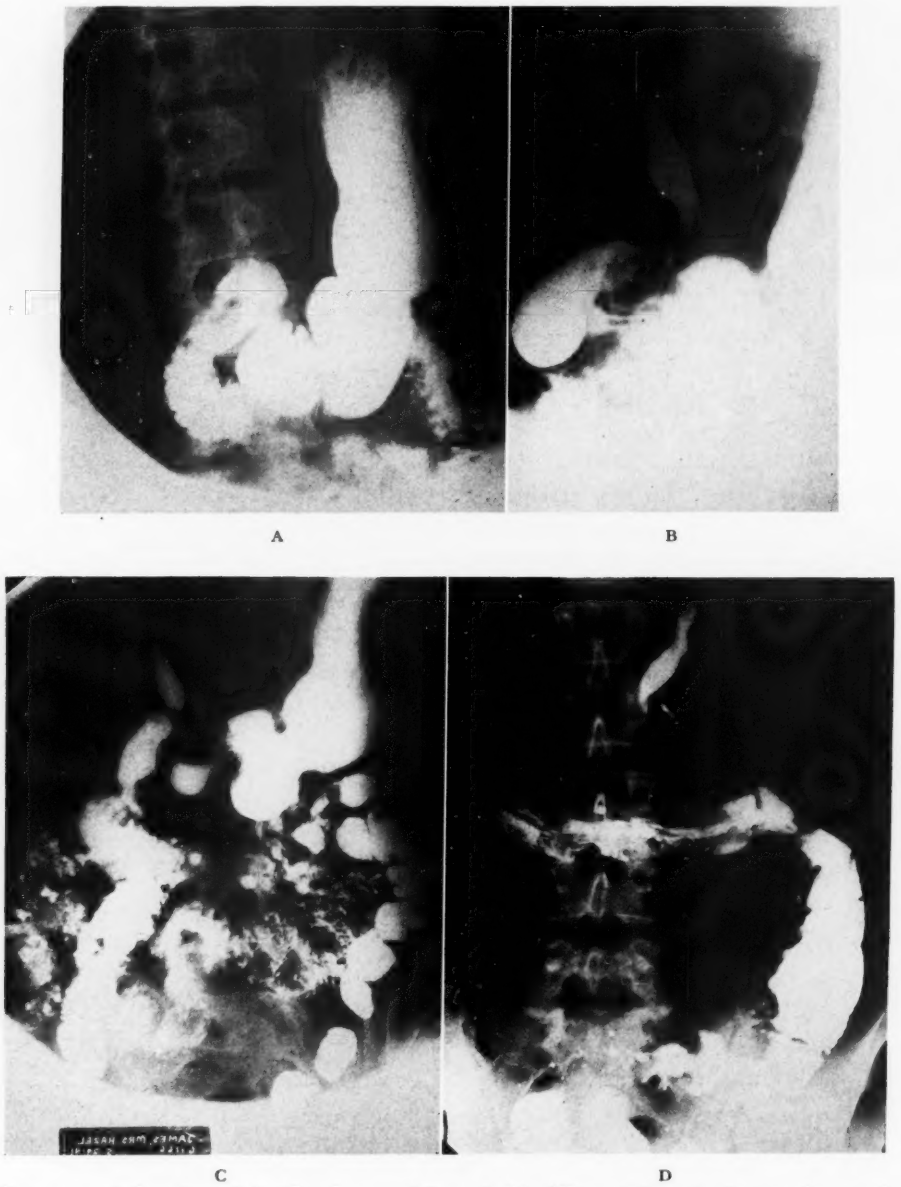


FIG. 1. A, deformity of duodenal cap with probable filling defects in first and second portions and dilatation of the second portion of duodenum. B, shadows interpreted as barium filled common bile duct and gallbladder. C, barium filling of common duct persists but shadow interpreted as gallbladder has disappeared. It was probably a configuration of duodenum resembling the gallbladder. D, in the six-hour film the common duct is still filled with barium.

Not until the permanent sections of the tissue had been studied was a final and correct diagnosis of lymphosarcoma made. Although the result in this case, freedom from symptoms for only two months and death from recurrence in three months does not commend this method of treatment, it seemed advisable to report this case for two reasons. As yet there are on record relatively few reports of cases in which the duodenum has been resected. A recent compilation published by Hunt shows a rapid progressive increase in the application of the operation and progress in its technical betterment. In all except our case, so far as we are able to ascertain, the operation has been performed for carcinoma involving the duodenum, pancreas or common bile duct. It is probable that the indications for the operation will be expanded to include not only the very rare resectable sarcomatous and inflammatory lesions but possibly on a rare occasion some lesion such as a duodenal fistula associated with a much mutilated duodenum.

CASE REPORT

University Hospital No. 71517. A housewife of forty-two had always been well until the onset of diarrhea and pain in the dorsal region of the back in August, 1940 (nine months prior to admission). Although these symptoms disappeared after ten days the patient never regained a sense of well being and was never entirely free of pain in the back. Four months later and following a few days of nausea she developed diarrhea and jaundice. Although both cleared within a week, a diagnosis of catarrhal jaundice was made. From that time on she continued to have pain in the epigastrium, increasing pain in the back, occasional attacks of vomiting and progressive loss of strength and weight. The jaundice, however, never recurred.

In March, 1941 (seven months after onset) an exploratory laparotomy was done. The surgeon stated that the pylorus, duodenum and pancreas appeared to be involved in an inflammatory process, which he interpreted upon the basis of a localized perforation of a peptic ulcer. Because the gallbladder was distended a cholecystotomy was done. The tube was removed after ten days and drainage of bile promptly stopped.

No relief of symptoms followed the operation.

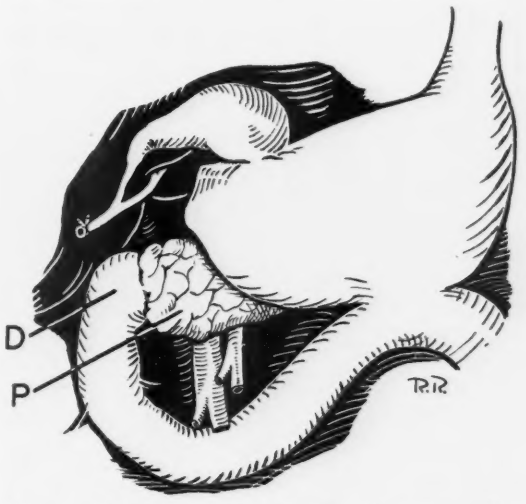


FIG. 2. Operation performed in this case. The closed duodenal stump, D, was sutured to the inverted stump of the pancreas, P, in prospect that the digestive action of the pancreatic juice would spontaneously establish an anastomosis which it presumably did.

An ulcer régime was instituted and this gave no relief.

One week prior to admission (May 15, 1941) the patient experienced a sudden feeling of faintness and weakness. This was followed by comparative relief of pain in the right upper quadrant and epigastrium and by fever. During her illness she had lost forty pounds.

Aside from certain irrelevant findings the physical examination revealed moderate pallor, evidence of recent loss of weight, a recently healed scar in the right hypochondrium and marked tenderness in the epigastrium and right hypochondrium. No masses were palpated. Laboratory studies were: hemoglobin 75 per cent, red blood cells 4,000,000, white blood cells 7,800 with a normal differential; urine negative; icteric index 2; hematocrit normal; normal gastric acidity; 50 per cent phenosulfathalein elimination; Mosenthal normal; stools (4) consistently positive for occult blood, and the prothrombin time was normal.

Radiographic studies showed the barium enema to be negative; the gallbladder was not visualized by cholecystography and the renal shadows were normal with good definition of ilipsoas lines. The esophagus and stomach appeared to be normal, a deformed duodenal cap communicated superiorly with a barium

filled pouch approximately 6 cm. long which was probably gallbladder; the common duct was also visualized; there was hypomotility

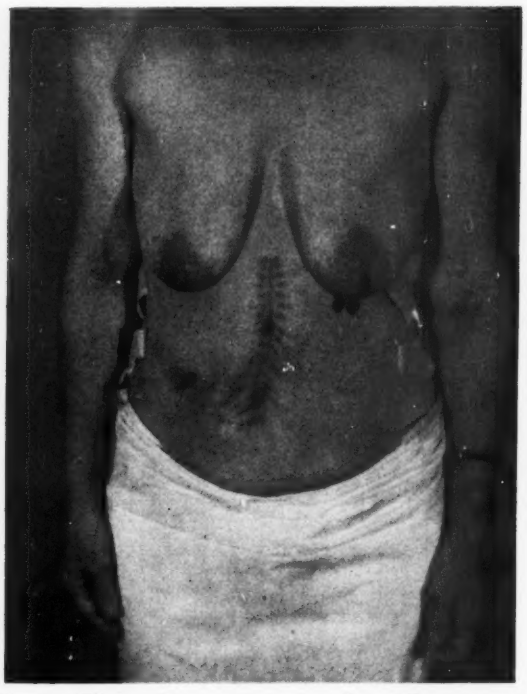


Fig. 3. The patient twenty-one days after operation showing healed operative and stab drainage wounds.

and dilatation throughout the second portion of the duodenum. Impression: cholecystoduodenal fistula. Clinical diagnosis: cholecystoduodenal or choledochoduodenal fistula.

Operation was performed after three days of preoperative preparation consisting of 1,000 cc. of whole blood and the daily parenteral administration of 100 Gm. of glucose in addition to a fair caloric intake. Large doses of thiamine chloride and civitimic acid were given by mouth. Out of a mass of tissue bound together by fresh adhesion the gallbladder, common bile duct and duodenum were dissected and no fistulous communication between these structures was found. The gallbladder was not grossly abnormal in appearance. The common duct was moderately dilated. The duodenum was obviously grossly abnormal. The first and second portions were much enlarged circumferentially and the wall felt very thick and had a deep reddish plum color. There were two large glands in the gastrohepatic omentum. The pancreas was normal to palpation and the general abdominal exploration revealed no other abnormality.

The duodenum was opened in the search for further information to aid in establishing a diagnosis. On the posterior and superior surfaces of both the first and second portions there was a large ulcer surrounded by a rolled border of firm thickened mucosa involving most of the remainder of the wall. Within the ulcer was the patulous opening of the common bile duct which measured about 8 mm. in diameter. Through this opening barium could readily pass up the common duct from the duodenum thus explaining the *x*-ray findings interpreted erroneously as a choledochoduodenal fistula.

A biopsy was taken from the border of the ulcer for diagnostic study in frozen section. It was the opinion of the pathologist that the tissue showed only chronic inflammation. It was decided, therefore, that resection of the duodenum was feasible and indicated. The stomach was divided 2 cm. proximal to the pyloric sphincter and the duodenum down to 4 or 5 cm. proximal to the legamentum Trietz was excised with the adjacent portion of the head of the pancreas. The severed common duct was ligated and the stumps of duodenum and pylorus were closed. The severed end of the pancreas was infolded and sutured to the invaginated end of the duodenal stump in the hope that the pancreatic duct would establish communication with the small bowel through the duodenal stump as a result of the digestive action of the pancreatic secretions.

Physiological continuity was re-established by anastomosing the gallbladder to the anterior wall of the stomach and the jejunum to the posterior wall. Sulfanilamide powder was applied to all surfaces in the field of operation. The operation was performed in one stage.

On the third day after operation a pancreatic fistula developed. It closed spontaneously on the twelfth day. Except for this complication the convalescence was uneventful.

During the third week after operation a course of *x*-ray therapy was given.

At the time of dismissal from the hospital (twenty-six days after operation), the patient was free of symptoms and felt quite well. She remained well for two months and after a month of recurrent pain and anorrhexia she died. Postmortem examination was not made.

The pathologist's report of the specimen follows: The specimen consists of first and second portions of duodenum with attached

pancreatic tissue. The common bile duct can be identified and shows dilatation to about 1½ cm. in diameter. The mucosal surface of the duodenum shows marked and extensive ulceration with a ragged, rolled margin and a thickening of the mucosa extending back 1 to 2 cm. from the margin of the ulcer. This area of ulceration involves the ampulla of Vater which cannot be specifically identified around the patulous dilated terminus of the common duct. Several sections represent the wall of the duodenum and pancreas. Those taken in the ulcerated area show loss of surface epithelium with a surface composed of necrotic granulation tissue with many dilated blood vessels. The margin of the ulcer shows duodenal glands which are quite well preserved. The wall of the duodenum is very extensively infiltrated by an unorganized mass of cells. These are supported by fine strands of connective tissue and many small thin-walled blood vessels. Extensive areas of necrosis are present. The individual cells in preserved areas are comparatively large and show marked variation in size and shape. The nuclei are large and vesicular with a prominent nucleolus and fine strands of chromatin material frequently accentuated toward the nuclear membrane. Multinucleated cells are occasionally seen. Mitotic figures are numerous. The cytoplasm is rather scanty and rather cloudy in appearance without definite granularity. These cells are invading the pancreas and compressing the pancreas, but this extension is quite limited. This is interpreted as a lymphosarcoma involving duodenal wall primarily.

REFERENCES

1. Brill, A. Primary carcinoma of the duodenum. *Am. J. M. Sc.*, 128: 824, 1904.
2. Raiford, T. S. Tumors of the small intestine. *Arch. Surg.*, 25: 122, and 25: 321, 1932.
3. Medinger, F. G. Malignant tumors of the small intestine: study of their incidence and diagnostic characteristics. *Surg., Gynec. & Obst.*, 69: 299, 1939.
4. Feldman, M. Clinical Roentgenology of the Digestive Tract. P. 567. Baltimore, 1938. Wm. Wood & Company.
5. Prey, D., Foster, J. M. and Dennis, W. Primary sarcoma of the duodenum. *Arch. Surg.*, 30: 675, 1935.
6. Whipple, A. O., Parsons, W. B. and Mullins, C. R. Treatment of carcinoma of the ampulla of Vater. *Ann. Surg.*, 102: 763, 1935.
7. Hunt, V. C. Surgical management of carcinoma of the ampulla of Vater and of the periampullary portion of the duodenum. *Ann. Surg.*, 114: 570, 1941.

MALIGNANT HEPATOMA

CASE REPORT

GREGORY L. ROBILLARD, M.D. AND CHARLES GOLDMAN, M.D.
Attending Surgeon, Norwegian Hospital Assistant Surgeon, Cumberland Hospital
BROOKLYN, NEW YORK

WE believe it worth while to report this case of malignant hepatoma because of the infrequent occurrence of primary carcinoma of the liver.

CASE REPORT

The patient had an uneventful medical history as a child and as an adult up to the age of forty-six. At that time he began to have periods of pain in the epigastrium. The pain occurred one and one-half hours after meals and was relieved by milk of magnesia. There was pyrosis and vomiting on only one occasion.

On January 2, 1927, the patient was operated upon at Prospect Heights Hospital. The hospital record is as follows:

A male, aged fifty-two, complained of epigastric pain with a history of vomiting on one occasion.

Laboratory data were as follows: Hemoglobin 82 per cent, red blood count 4,100,000, white blood count 7,800, polymorphonuclears 75 per cent, small monocytes 20 per cent, large monocytes 2 per cent, color index 1.0.

A large ulcer the size of a quarter with a deep crater was found upon the posterior wall of the stomach near the greater curvature about 5 cm. from the pyloric ring. The induration extended over an area about the size of a silver dollar. A few glands were present in the gastrocolic mesentery.

A posterior no-loop gastrojejunostomy was performed. This procedure was decided upon because of the patient's loss of strength and weight and the size of the ulcer.

The patient was well until March, 1941, a period of fourteen years, when he was admitted to Kings County Hospital and his case diagnosed as diverticulitis of the rectosigmoid colon and also gastric ulcer. On April 27, 1941, it was decided that there was no evidence of any intrinsic lesion of the stomach or duodenum and the patient was discharged.

On July 31, 1942, the patient was admitted to the Brooklyn Cancer Institute with a diagnosis of carcinoma of the stomach. The hospital records are as follows:

From March, 1942, to the date of admission, July 31, 1942, the patient complained of a constant pain in the gastric region. In March he had a gastric hemorrhage. He stated that he had lost twenty pounds in the three months preceding his admission. In August a mass about 10 cm. in size was felt beneath the left rectus muscle. The same moved with respiration. The patient was suffering with partial intestinal obstruction at the time of admission. In September, he complained of severe cramp-like abdominal pains. The entire abdomen was moderately distended and tympanitic. The patient was unable to take fluids by mouth and vomited a yellowish fluid.

Laboratory findings were as follows: August 7, hemoglobin 41 per cent, red blood count 3,800,000, white blood count 6,450, polymorphonuclears 69 per cent, monocytes 8 per cent; August 31st, hemoglobin 46 per cent, red blood count 3,670,000; September 9th hemoglobin 53 per cent, red blood count 3,850,000, white blood count 6,500, polymorphonuclears 72 per cent, monocytes 2 per cent; September 30th, hemoglobin 64 per cent.

On August 10th, the urea nitrogen was 13, creatinine 1.2; sugar 130, sodium chloride 520, total serum proteins 5.8 mg. per cent. The gastric analyses on that same day revealed total acids 8 in the fasting specimen; free acids 0; bile 0; blood positive; lactic acid negative.

No abnormal intrinsic pathological disorder in the stomach or duodenum was seen by *x*-ray on August 6, 1942. The lesser curvature of the stomach was thought to be compressed by a contiguous structure, most likely the left lobe of the liver. A loop of the intestine which was thought to be the gastroenterostomy was found in close proximity to the pylorus on the greater curvature. However, barium left the stomach via the pylorus and the

duodenum. There was a soft tissue density in the midabdomen and a few isolated loops of small intestine in the left lower quadrant of the abdomen, which were dilated and contained fluid levels.

Six hours after the administration of barium by mouth there was a rather marked distention of these loops with gas and barium. At the end of twenty-four hours much of the barium was still retained in this localized gut dilatation. The contour of the transverse colon, while grossly intact, contained several mucosal irregularities and it was planned to study this area again when the patient's condition permitted. Examination of the abdomen forty-eight hours after the administration of barium by mouth revealed a small amount of barium scattered throughout the entire colon.

From the above *x*-ray findings it was concluded that there was a partial mechanical obstruction of several loops of the small bowel in the left lower quadrant, a large tissue density in the mid central abdomen, and mucosal irregularity of the transverse colon.

A later study of the formerly suspicious area of mucosal irregularity in the transverse colon showed the irregularity to be much less marked than on previous examination. The irregularity was thought to be due to an extrinsic cause, such as a small amount of ascites or contiguous pressure. The localized area of small gut dilatation in the left lower quadrant was still present but less marked than on the previous examination.

A flat plate of the abdomen on September 2nd was made with vertical rays at the bedside and revealed a moderate gas accumulation in the colon and small intestine. At that time definite evidence of intestinal obstruction was not detected, but it was suggested that an interval study be made to determine whether the gas accumulations were increasing. A rectal examination was negative.

The patient was relieved of his vomiting by the passage of a Levine tube. Six blood transfusions of 500 cc. each of citrated blood were given between August 20th and October 8, 1942. In spite of the treatment, the patient grew steadily worse and expired on October 14, 1942.

Permission was received for postmortem examination and the gross and microscopic findings of the pathologist, Dr. James A. Mitchell, are as follows:

The body is that of an adult white male, appearing to be seventy years of age, 5 ft. 6 in. tall, weighing approximately 100 pounds. An old operative scar is present in the upper right rectus. Edema of the feet and ankles is noted.

A midsection of the body was made and the sternum removed.

The peritoneal cavity contained about 2,000 cc. of clear straw-colored fluid. Many adhesions of the omentum in the region of the gallbladder and the duodenal portion of the intestine are noted.

The pleural cavities each contain about 300 cc. of a straw-colored fluid.

The lungs are bound down to the parietal chest wall by many fibrous adhesions. The lungs on section are reddish-grey in color; both lower lobes are dark red in color and frothy bloody fluid is expressed from the bronchioles on pressure. There is no gross evidence of consolidation.

The pericardium shows no free fluid or adhesions. The heart is normal in size; the myocardium is of a pale red color. On section the valves show no evidence of thickening or vegetation. The aorta is smooth and glistening. The coronaries are patent.

There is noted a gastroenterostomy the opening of which is patent. The stomach mucosa is smooth and shows no evidence of ulcer or tumor. The pylorus is patent and the pyloric region and duodenum show no evidence of neoplasm. The remainder of the gastrointestinal tract shows no change of note. The pancreas is normal in size and on section is light yellowish in color, moderately firm in consistency. The spleen is of normal size; the surface is slate blue. On section the coat is dark red and firm and the trabeculae are prominent.

The liver is enlarged and weighs 2,400 Gm. In the right lobe there is a large nodular tumor projecting above the surface of the liver and on section is about the size of a grapefruit (about 10 cm. in diameter). It is light yellowish in color, rather soft in consistency and shows scattered areas of degeneration and hemorrhage. It is sharply circumscribed from the surrounding liver tissue. In the left lobe of the liver there is also noted another mass projecting above the surface of the liver, which on section is about the size of a small orange (about 5 cm. in diameter). It has a similar appearance and is sharply circumscribed.

The gallbladder is distended and the common duct is dilated, apparently owing to partial

obstruction of the duct by a number of glands. There is no evidence of any stones within the bile ducts. The portal vein is also surrounded by a number of glands. The ampulla of Vater is patent.

The kidneys are normal in size. The capsules strip easily, leaving smooth surfaces. The cut surfaces are dark red in color. The cortices are normal in size and the markings are distinct. The ureters and the urinary bladder show no gross pathological disturbance. The prostate is normal in size and on section is light greyish in color and shows a few small circumscribed adenomatous areas.

Microscopically, there is cloudy swelling of the myocardium. The aorta is normal. There is congestion, atelectasis, and anthracosis of the lungs. Sections from the stomach show some atrophy of the mucosa and moderate thickening of the muscular coat. No evidence of ulceration is noted. The pancreas is normal. The spleen shows some congestion and interstitial fibrosis.

Section of the tumor from the liver shows the presence of a neoplasm which is composed of a diffuse growth of large polyhedral shaped cells with pale pink acidophilic cytoplasm and ovoid-shaped nuclei. The cells have no

Fig. 1. Low power microphotograph showing a diffuse growth of polyhedral shaped cells.

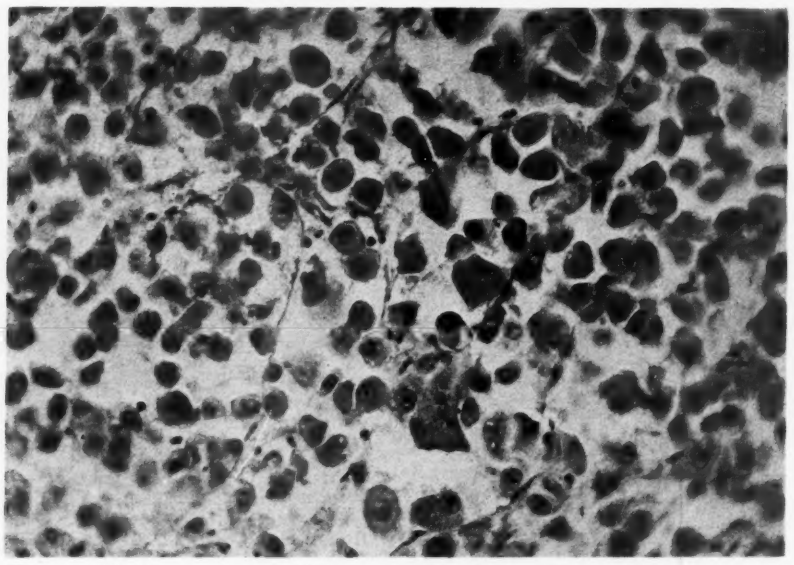


Fig. 2. High power microphotograph showing cells resembling liver cord cells, giant cells and mitotic figures.

definite organoid arrangement and running between them is a septa of fibrous connective tissue. The cells resemble very large liver cord cells. Many giant cells are noted throughout the tumor and many mitotic figures are observed. Areas of degeneration and hemorrhage are also noted. (Figs. 1 and 2.)

The mesenteric lymph node upon section shows no evidence of metastatic tumor. The kidneys show some thickening of the coats of the vessels but the glomeruli appear normal in architecture. The prostate shows some hyperplasia in the glands and some cystic dilatation of the glandular structures. No histologic evidence of tumor is noted.

Anatomical Diagnosis: Congestion and edema of the lungs; cloudy swelling of the myocardium; congestion of the spleen; chronic interstitial nephritis; neoplasm of the liver, hepatoma and ascites. The cause of death was malignant hepatoma.

SUMMARY

A case of a sixty-eight year old white male with a history of illness from March, 1941, until his death on October 14, 1942, with no definite diagnosis is given.

CONCLUSIONS

A diagnosis of primary carcinoma of the liver is difficult to make either clinically or with the aid of *x*-ray or laboratory findings. We can add nothing that might aid in making a diagnosis, but wish to call attention to Ewing's statement that "In this group (multiple liver-cell carcinoma or hepatoma) are included the highly malignant, rapidly growing tumors occurring in livers in which cirrhosis is either absent or so slight as to be of secondary importance. The peculiar clinical course, gross appearance of the liver and the microscopical structure which is often atypical, justify the separate consideration of these cases. There is, however, no sharp division between this group and solitary massive carcinoma, on the one hand and multiple carcinoma following cirrhosis on the other."[1]

REFERENCE

Ewing, James. Neoplastic Disease. Philadelphia, 1941. Saunders.

MANAGEMENT OF GASTROJEJUNOCOLIC FISTULA*

GILBERT B. TEPPER, M.D. AND THEODORE B. MASSELL, M.D.
LOS ANGELES, CALIFORNIA

ALTHOUGH gastrojejunocolic fistula today is no longer a rare entity, it still presents one of the most formidable of surgical problems. As recently as 1925, Verbrugge[6] was able to find in the literature only ninety-five cases of gastrojejunocolic fistula resulting from gastrojejunal ulcer while he recorded 121 cases of gastrocolic fistula secondary to malignancy of the stomach or colon. Owing to earlier diagnosis and treatment the malignant type of fistula is now rarely seen, whereas the type secondary to peptic ulcer of the jejunum is relatively much more common. Bornstein and Weinshel[2] collected reports of 322 cases in their review of May, 1941, an addition of 227 to Verbrugge's original ninety-five in a little over fifteen years.

The presence of gastrojejunocolic fistula may be suspected in any patient, especially a male, who presents the picture of diarrhea, foul belching, anemia, and progressive emaciation anywhere from a few weeks to several years after a gastroenterostomy for peptic ulcer. Pain or burning, frequently severe in jejunal ulcer, generally disappears with the formation of a fistula. The clinical picture may resemble pellagra or non-tropical sprue. The diagnosis may be established by roentgenogram or by demonstrating the gastrocolic short circuit by a color enema or one containing readily recognizable particulate matter such as lamp black. In the roentgenographic demonstration of the fistulous tract a barium enema is preferable to an upper gastrointestinal series since a fistula may often not be apparent when barium studies are made of the stomach and small intestine. Missed diagnoses are unlikely if the barium mass is watched under the fluoroscope as it passes up through the large bowel.

Obviously the first consideration in the treatment of gastrojejunocolic fistula concerns the prevention of this complication. Every fistula of this type represents a gastrojejunal ulcer and almost every instance of the latter represents a patient who should not have had a gastroenterostomy. It is unfortunate that there is so much disagreement in the literature with regard to the end results of gastrojejunal anastomosis for peptic ulcer. However, even the most enthusiastic advocates of this procedure now agree that it should be avoided in males in whom ulcer is associated with high acid values. Walters[7] deduces from the extremely low incidence of jejunal ulcer in women that, "gastroenterostomy is a safe and usually a satisfactory procedure for the treatment of duodenal ulcer in the female." In view of the higher mortality of the gastric resection in elderly ulcer patients, some surgeons still prefer gastrojejunostomy for this group, especially when the acid values are low. While Walters and his colleagues,[3] of the Mayo Clinic, still retain this belief, it is interesting to note that in their recent series of fifty gastrojejunocolic fistulas, fifteen of the patients (30 per cent) were over fifty years of age. Hence it would seem that gastrojejunal anastomosis may not be any more satisfactory in the older age group than in young patients. Certainly the most important step in the prevention of this type of fistula is a marked limitation in the previous overenthusiastic use of gastroenterostomy for duodenal ulcer. Moreover, when the latter procedure is performed, it should not be accompanied by pyloric exclusion. Lahey[4] has pointed out that surgical exclusion of duodenal contents from the stomach predisposes to ulcer around the anastomosis.

* From the Department of Surgery, Ross-Loos Medical Group, Los Angeles, California.

Apparently even partial gastrectomy fails to guarantee an ulcer cure. Lahey reports five jejunal ulcers in 200 patients with subtotal resection of the stomach. Thus adequate prevention of gastrojejunocolic fistula involves not only careful selection of operative procedure but also the realization that the operation is only part of the treatment, not in itself the complete cure. Long careful follow-up with dietary regulation and the usual hygienic precautions of medical therapy for ulcer are a necessary sequel to operation. Jejunal ulceration and fistula are to be expected if patients regard postoperative recovery as the prelude to dietary excesses, bad eating habits, excessive use of tobacco and alcohol.

Once gastrojejunocolic fistula has developed the treatment is surgical for nonoperative therapy carries essentially a 100 per cent mortality. To be sure a careful preoperative medical régime is necessary to restore the depleted nutritional state, combat dehydration and increase the hemoglobin to a point at which operation can be tolerated. This involves bed rest, high caloric and high vitamin feedings of readily assimilated material, large venoclyses of fluid and electrolytes, transfusion of plasma and whole blood. Even with the best preoperative régime the operative mortality is high because poor risk patients are subjected to the double hazards of operation on the stomach and on the colon.

Choice of operative procedure must necessarily vary with the patient's general condition and the local conditions in the operative field. Excision of the fistula is a necessary part of every procedure and under ideal conditions should be combined with gastric resection at a sufficiently high level to include most of the acid bearing glands. The futility of another gastrojejunostomy without an attempt to obliterate the source of the previous jejunal ulcer should be apparent. On the other hand, excision of the fistula, separation of the gastroenteric anastomosis and restoration of the original alimentary continuity may be regarded only as a first stage to be followed after a brief interval by gastrectomy. Many patients who might be unable to survive the entire procedure at one operation would withstand the divided operation, especially if the technic of aseptic anastomosis described by Arthur Allen[1] is used in the first stage.

There are numerous reports of cases in the literature in which only the first operation, i.e., restoration of continuity, was performed, but the recurrence rate of the original duodenal ulcer is high under these circumstances. The following case illustrates the rationale of following restoration with gastrectomy:

CASE REPORT

On April 15, 1939, a fifty-two year old male was admitted to the Queen of Angels Hospital because of diarrhea, progressive weight loss despite voracious appetite, fetid breath, and regurgitation of a very foul material, all of some six months' duration.

In 1925, a posterior gastroenterostomy had been performed elsewhere for duodenal ulcer. Shortly after this operation, he began to have cramp-like pains in his left upper quadrant, not affected by dietary therapy. In 1934, an operation for abdominal adhesions had been performed without alleviation of cramps.

An examination of the patient revealed emaciation and moderate dehydration. His slightly distended abdomen was tympanitic and showed hyperactive peristalsis. A secondary anemia was partly masked by dehydration. A gastrointestinal series revealed findings suggestive of gastrojejunocolic fistula, but definite confirmation was obtained by barium enema. (Figs. 1 and 2.)

After a preliminary period of intensive preoperative preparation Tepper performed a laparotomy under spinal anesthesia. A fistulous opening was found between the jejunum and transverse colon opposite the stoma of a posterior gastroenterostomy. The fistula first was separated and repaired after which the gastrojejunostomy was dissected free and repaired. Recovery was uneventful and the patient was discharged on the fourteenth postoperative day.

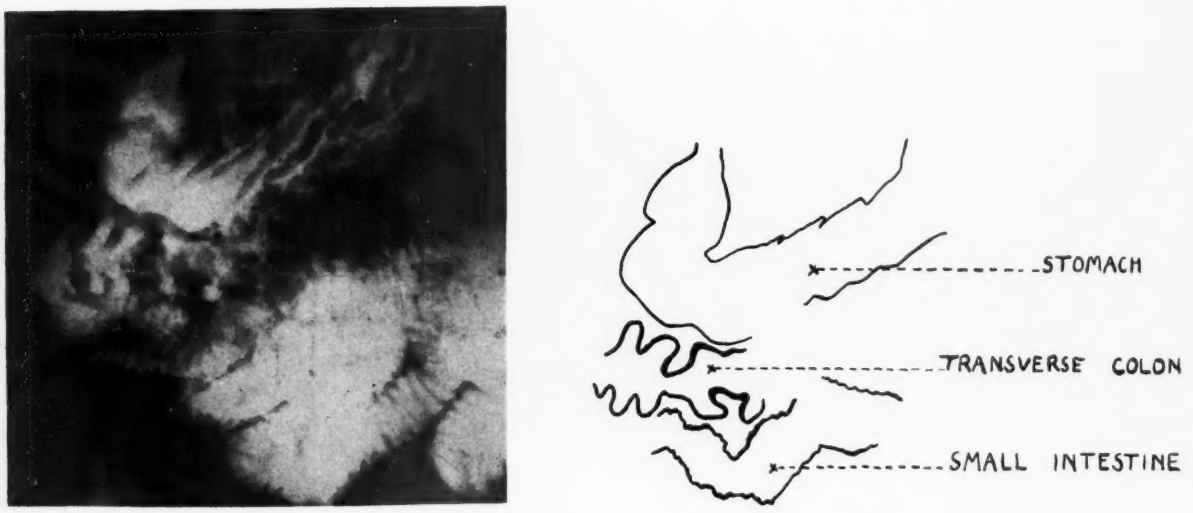
He failed to co-operate for postoperative follow-up, but returned on February 25, 1941

complaining of recurrence of pain in his left upper quadrant and of marked constipation.

Physical findings at this time were noncontributory except for abdominal hyperperistalsis. A careful laboratory and roentgenogram examination including a gastrointestinal barium series failed to demonstrate any cause for his pain. (Fig. 3.)

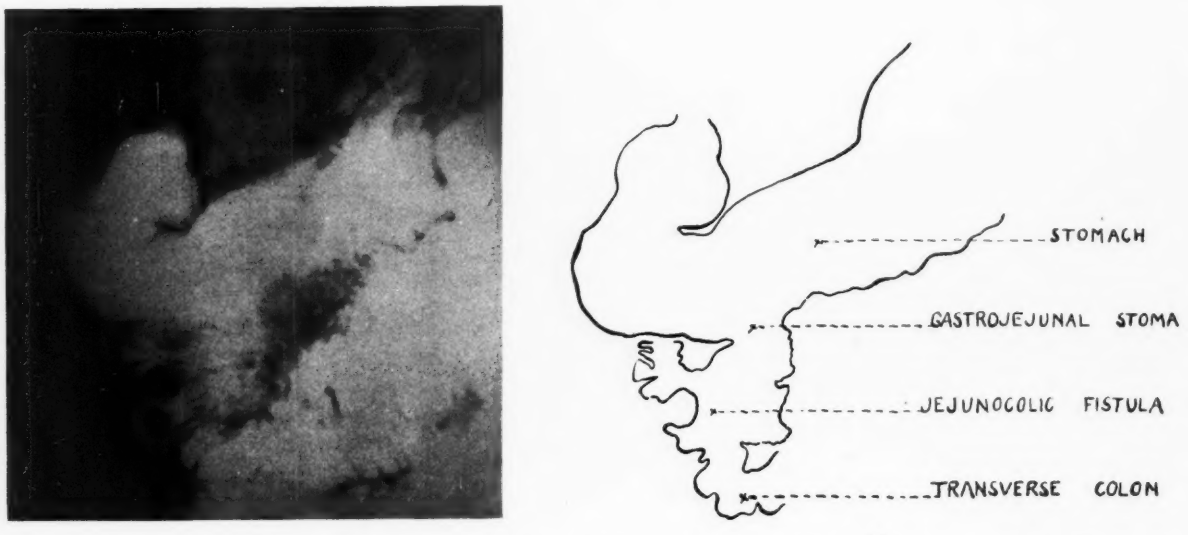
On March 5, 1941, while under observation, he vomited about 600 cc. of fresh blood and went into a state of circulatory collapse. With application of appropriate therapy, including a blood transfusion, his condition improved temporarily; however, bleeding continued and despite two more transfusions his hemoglobin dropped to 28 per cent, and his red cell count to below two million by March 9, 1941. Another 1,500 cc. of whole blood was given on that date and an operation was performed on the following day.

A duodenal ulcer was found which penetrated the posterior wall and had eroded into the pancreas and the pancreaticoduodenal artery. Considerable gastritis was noted. A subtotal



A B

FIG. 1. A and B, gastrointestinal series fails to reveal a fistula definitely, but there is general hypermotility so that the stomach empties rapidly and barium appears almost at once in the transverse colon.

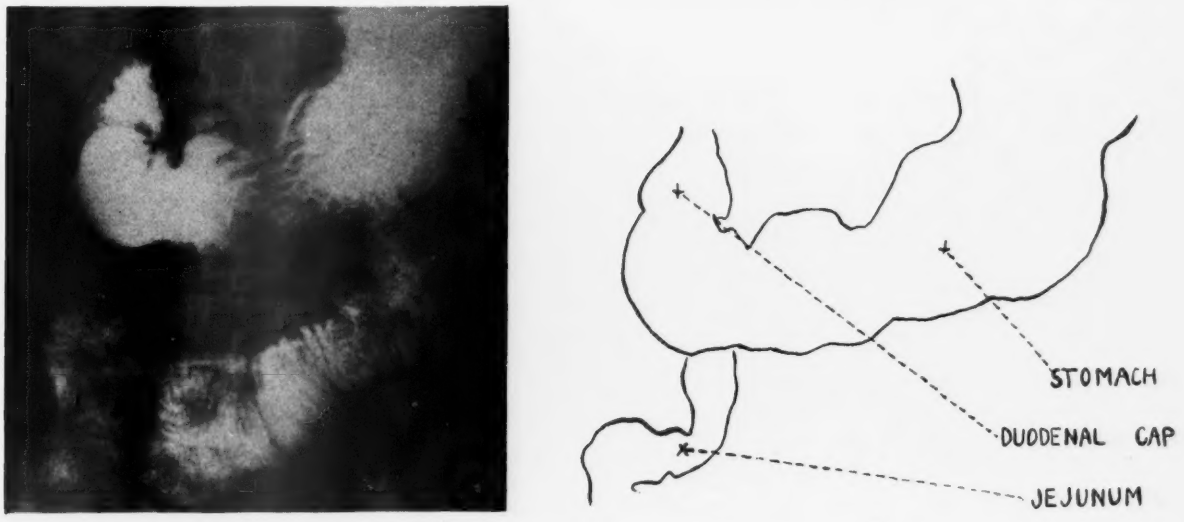


A B

FIG. 2. A and B, barium enema; barium may be followed from the transverse colon through the fistula into the stomach by way of the gastrojejunal stoma.

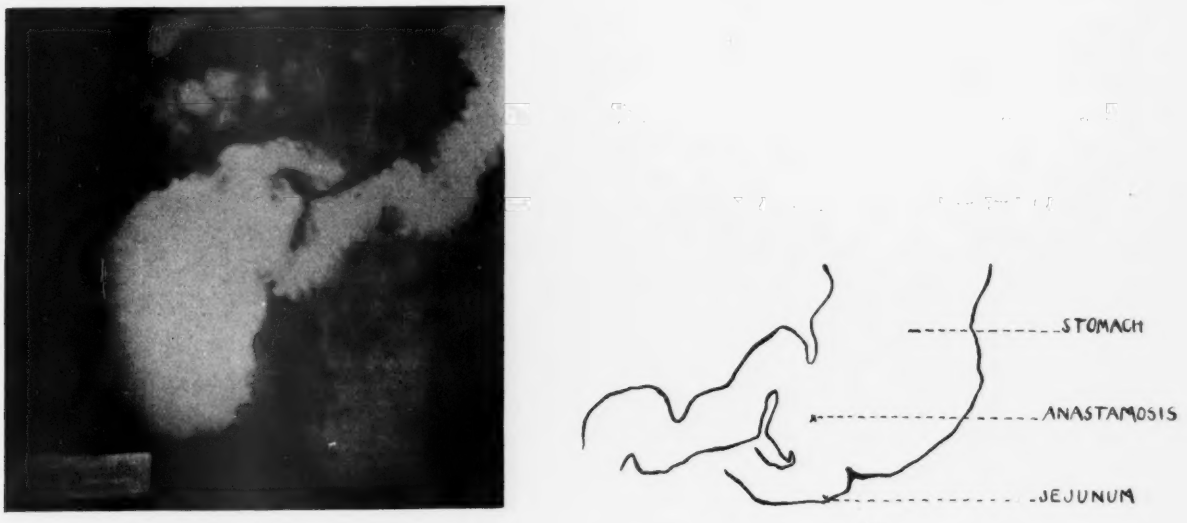
gastrectomy was performed with anterior Pólya anastomosis. The operation was followed by two more transfusions.

Ewald test meal on November 4, 1941, revealed complete absence of free hydrochloric acid and total gastric acidity of only sixteen degrees.



A B

FIG. 3. A and B, gastrointestinal series after restoration of normal alimentary continuity. Duodenal cap appears normal.



A B

FIG. 4. A and B, gastrointestinal series after gastric resection. Barium passes readily from the gastric stump through Pólya anastomosis into the jejunum.

The patient's recovery was uneventful and he was discharged on his twenty-first postoperative day. In the subsequent follow-up the patient states that he is free of abdominal pain for the first time in fifteen years. A gastroscopy on October 16, 1941, showed smooth gastric and jejunal mucosa with no evidence of gastritis or ulceration. Gastrointestinal roentgenograms on October 30, 1941, corroborated the gastroscopic findings. (Fig. 4.) An

This case illustrates the desirability of early gastrectomy after repair of gastrojejunocolic fistula. Although this patient was fifty-two years old, the original etiologic factors causing his duodenal ulcer were still present. Consequently, the recurrence of that ulcer was to have been anticipated. The only surprising aspect is the failure of the roentgenologist to find

a penetrating posterior wall ulcer of this type.

Another approach to the handling of gastrojejunocolic fistula has recently been presented by Pfeiffer.[5] He advocates establishment of a loop colostomy proximal to the fistulous opening in the colon. In his series, colostomy was followed by so much general nutritional improvement and so much improvement in the local condition that most of the patients were able to withstand adequate resection at the time of closure of the fistula.

Whether operation is performed in one stage or two, whether closure of the fistula or establishment of a colostomy is done in the first stage, the final procedure should include gastric resection. The previous existence of jejunal ulcer and fistula is evidence that anything short of this procedure is likely to be a therapeutic failure.

SUMMARY

1. Gastrojejunocolic fistula is becoming more frequent as a consequence of gastroenterostomy for peptic ulcer.

2. The symptoms and diagnosis are discussed briefly.

3. This condition may be prevented by more careful selection of operative procedure for peptic ulcer and better medical follow-up. Gastroenterostomy should be avoided in males with duodenal ulcer.

4. Treatment of the fistula requires excision and gastric resection. The operation may advantageously be divided into two stages.

5. A case report is presented.

REFERENCES

1. Allen, Arthur. An aseptic technic applicable to gastrojejunocolic fistula. *Surgery*, 1: 338, 1937.
2. Bornstein, M. and Weinshel, L. R. Gastrojejunocolic fistula. *Internat. Abstr. Surg.*, 72: 459–465, 1941.
3. Gray, H. K., Walters, W. and Priestley, J. T. Report of surgery of the stomach and duodenum for 1940. *Proc. Staff Meet., Mayo Clin.*, 16: 721, 1941.
4. Lahey, F. H. Diagnosis and management of gastrojejunal ulcer and gastrojejunocolic fistula. *Surg. Clin. North America*, 20: 767, 1940.
5. Pfeiffer, D. B. Surgical treatment of gastrojejunocolic fistula. *Surg., Gynec. & Obst.*, 72: 282–289, 1941.
6. Verbrugge, Jean. Gastrojejunocolic fistulas. *Arch. Surg.*, 1: 790, 1925.
7. Walters, W. and Clagett, O. T. Gastrojejunocolic ulcer and fistula. *Am. J. Surg.*, 46: 94–102, 1939.

GALLSTONE ILEUS*

PYLORIC OBSTRUCTION CAUSED BY GALLSTONE

WILLIAM I. SHEINFELD, M.D. AND HARRY MACKLER, M.D.
Assistant Surgeon, Coney Island Hospital — Associate Surgeon, Coney Island Hospital
BROOKLYN, NEW YORK

GALLSTONE ileus is an uncommon condition in the experience of any one physician or surgical service. Nevertheless, it occurs often enough to be considered more frequently as a diagnostic entity and attempts should be made to reduce the high attendant mortality (50 to 60 per cent).[1,2]

Ileus, as a complication of biliary tract disease, is considered difficult or impossible of recognition by many authors.[1,2,3] It is our contention that it may be suspected with enough frequency so that early surgery will be performed to supplant the usual late ineffective surgery.

Continued publication and discussion of case reports will bring this clinical entity to the attention of physicians. The likelihood of earlier diagnosis and suitable therapy in general will be greater, and eventually the mortality will be reduced. Gallstone ileus comprises 3 to 5 per cent of all intestinal obstructions.[2,3]

This case is presented with the above mentioned reasons in mind. Two features are noteworthy: (1) the unusual size of the calculus (6½ by 4 by 4 cm.), probably one of the largest reported, (Fig. 2) and (2) the site of the obstruction, namely, the duodenum.

CASE REPORT

A white female, sixty-two years of age, was admitted to the medical service at the Coney Island hospital on October 16, 1942, with the primary complaint of persistent vomiting for the past seven days. There was no pain. There had been several previous attacks similar to this and a two-year history of gallbladder disease without jaundice. During the present illness there was marked constipation. However, enemas were evocative of small amounts of fecal matter and flatus. General physical examination proved to be essentially negative. The abdomen was pendulous with slight tenderness on deep pressure in the upper right quadrant.

A provisional diagnosis of chronic cholecystitis, mild acidosis, chronic bronchitis and arteriosclerotic heart disease was made.

Routine laboratory findings revealed a positive Wassermann, and leukocytosis on October 20th of 17,000 white blood cells with 83 per cent polymorphonuclears, which was reduced by October 26th to 10,000 white blood cells with 75 per cent polymorphonuclears. Blood chemistry tests showed glucose 125 mg. per cent, urea nitrogen 12.5 mg. per cent, and creatinine 2.9 mg. per cent. Urinalysis was negative.

A flat *x*-ray plate of the abdomen on October 19th revealed a large calculus in the right upper quadrant apparently within the gallbladder. (Fig. 1.) The diagnosis was cholelithiasis.

The patient was kept on the medical service until October 23rd, when she was transferred to surgery. Symptoms persisted without abatement.

Repeated attempts to intubate the duodenum were unsuccessful. *X*-rays showed no evidence of intestinal obstruction.

On October 27th, the diagnosis of gallstone ileus was made. As soon as the patient could be properly prepared operation was performed. The stomach was greatly distended and contained a hard mass at the pylorus, which subsequently proved to be the gallstone. The gallbladder was small, contracted, cicatrized and contained neither bile nor calculi. There was a fistulous tract from the gallbladder to the duodenal gastric junction. The calculus was impacted in the duodenum and extended through the pylorus into the stomach.

In order to clarify the picture of the condition involved, the gallbladder was separated from

* From The Coney Island Hospital, Service of Dr. George Webb, Brooklyn.

the stomach. This opened the gallbladder-duodenal fistula. Incision was made into the stomach and the calculus extracted. The opening in the stomach was closed and the diseased gallbladder was removed.

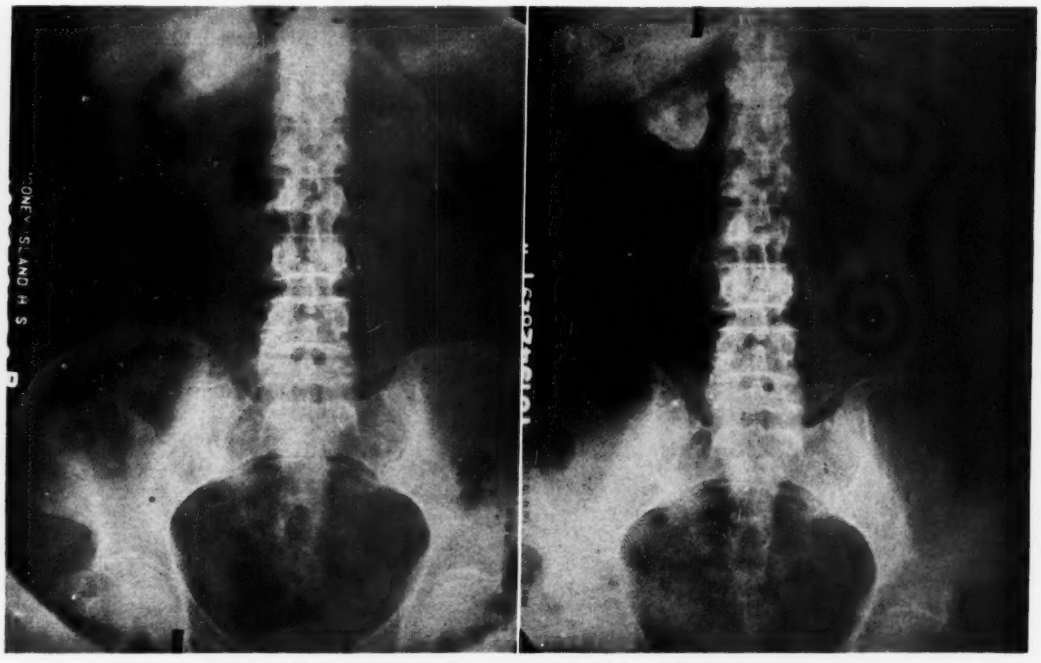


FIG. 1. *X*-ray demonstrating large calculus.

The patient responded poorly to the operation, developing hyperthermia and circulatory collapse several hours afterward. In spite of supportive therapy, glucose intravenously, transfusion, and the use of oxygen, the patient expired on the first postoperative day.

REMARKS

At first it was considered that chronic cholecystitis was the cause of the persistent vomiting. Intestinal obstruction was not recognized. This is the usual time-honored error recorded in numerous reports on the subject.[5] However, if we accept the modern trend and consider acute gallbladder conditions an indication for immediate surgery, after suitable preparation, this error will not continue. Automatically, all reasons for delay in operation upon patients with gallstone ileus will vanish and early surgery will result even if the complication of ileus is not recognized.

It is ironical that where from the point of view of local disturbance, the prognosis should be good, it is nevertheless poor. The problems of local gangrene or compromise of the circulation of the segment of gut involved, are almost always absent. The obstruction can be readily relieved by simple enterotomy, calculus extraction and intestinal repair. However, because of the poor general condition of the patient, the operative complications and mortality are high.

If there has been a prolonged period of vomiting prior to surgery, simple relief of the obstruction without operative attention to the gallbladder must be practiced, in spite of all temptation to divide adhesions and attack the diseased gallbladder.

The presence of a cholecystoduodenal or gastric fistula is not incompatible with prolonged life in a good state of health.[2] Should there be subsequent symptoms referable to internal gallbladder fistula, further surgery can be carried out at a later date, when there is no associated problem of intestinal obstruction with the attendant derangement in blood chemistry, hemoconcentration, etc. Frequently, gallbladder intestinal fistulas will close spontaneously after the calculus has passed.[4]

The site of the obstruction is usually the terminal ileum,[2,4,7,8,9] at varying distance from the ileocecal valve, depending upon the size of the calculus and the diameter of the intestinal lumen. One or several calculi may be present in the gut. In this case due to the exceedingly large size, the calculus was in the duodenum and extended through the pylorus into the antral portion of the stomach. The obstruction was at first classically intermittent becoming almost complete as the clinical picture developed.

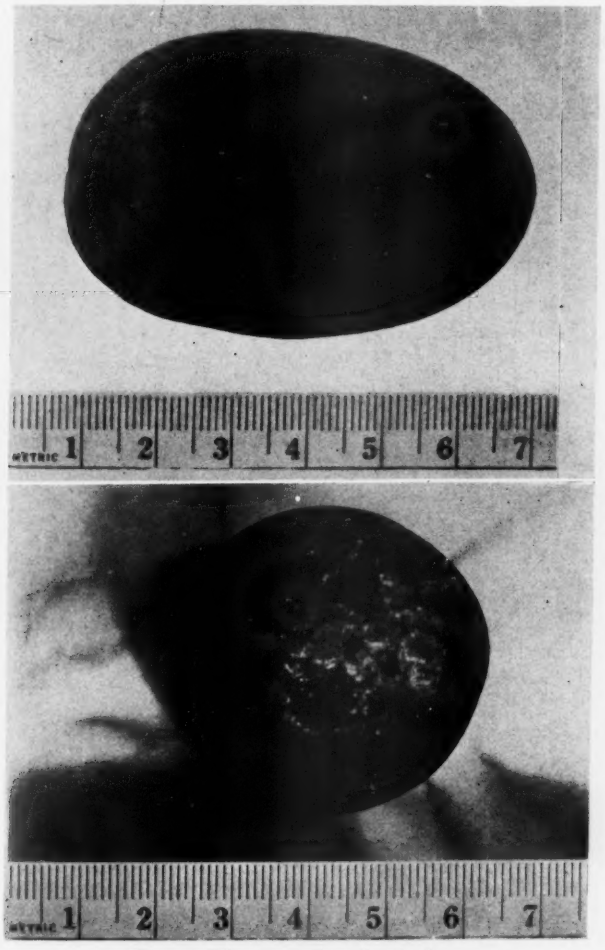


FIG. 2. Photographs of calculus.

After a review of many reported cases,[1–12] we believe that the symptomatology conforms with a definite pattern, though occasionally it may be difficult to recognize. There is usually a history of chronic gallbladder disease of varying duration, months to years. Then there is the onset of the acute phase of the ailment, numerous attacks of colicky abdominal pain associated with persistent vomiting but incomplete obstruction. Feces and gas continue to be passed almost until the time of operation. Association of incomplete or occasionally complete intestinal obstruction with a history of chronic gallbladder disease in an elderly individual should arouse suspicion to the presence of gallstone ileus. A flat *x*-ray plate of the abdomen may be of help; a large calculus may be visualized. These cases are caused by large calculi. The typical findings of small bowel obstruction may be present, that is, the dilated intestinal loop with fluid levels or visualization of valvulae conniventes. Occasionally, as a result of the gallbladder intestinal fistula, air may be seen outlining the common and hepatic

ducts or even the gallbladder. A small amount of barium given by mouth may be seen entering the biliary tract.[6]

CONCLUSION

A case of gallstone ileus is presented. The importance of this syndrome, its diagnostic features and therapy are discussed.

REFERENCES

1. Colcock, Bently P. Intestinal obstruction due to gallstones. *Labey Clin. Bull.*, 2: 47, 1940.
2. McQueeney, A. M. Intestinal biliary fistula and intestinal obstruction due to gallstones. *Ann. Surg.*, 110: 50–54, 1939.
3. Dulin, J. W. and Peterson, F. R. Intestinal obstruction due to gallstones. *Arch. Surg.*, 38: 351, 1939.
4. Wakefield, E. G., Vickers, P. N. and Walters, W. Intestinal obstruction caused by gallstone. *Surgery* 5: 670–3, 1939.
5. Diak, S. L. and Fagan, E. R. Intestinal obstruction due to gallstone. *Surg. Clin. North America*, 14: 1325, 1934.
6. Paul, L. W. Cholecysto-duodenal fistula with gallstone obstruction of small intestine. *Radiology*, 23: 363–5, 1934.
7. Gardiner, H. Intestinal obstruction by gallstone. *Lancet*, 2: 354, 1933.
8. Rosenthal, J. Intestinal obstruction caused by impacted gallstones. *Lancet*, 2: 192–3, 1934.
9. Mast, W. H. Recurrent intestinal obstruction due to gallstone. *Am. J. Surg.*, 32: 516–18, 1936.
10. Snyder, L. H. Unrecognized gallstone obstruction of the intestine. *South. M. J.*, 31: 1275–6, 1938.
11. Skemp, A., and Travnicek, F. G. Gallstone obstruction of the bowel. *Am. J. Surg.*, 32: 166–68, 1936.
12. Waugh, J. M. Duodenal obstruction secondary to chronic cholecystitis with cholecystoduodenal fistula. *Proc. Staff Meet., Mayo Clin.*, 12: 694–8, 1937.

A METHOD OF TREATING CYSTIC TUMORS

FRANCIS M. LYLE, M.D.*
SPOKANE, WASHINGTON

MOST cystic tumors are treated by surgical removal with excellent results. But there are times when simple cystic tumors are so located that surgical removal presents a greater problem and greater risk as, for example, pituitary cystic tumors.

A sclerosing solution has been used in brain tumors, serous cysts of kidneys, pancreatic cysts, and simple cysts elsewhere anatomically located. I should like to present a new method of applying the sclerosing solution, with a case report.

After surgical exposure of the cyst which is difficult to remove, it is packed with one-inch gauze, impregnated with sodium morrhuate. The end of the gauze strip is brought to the surface for drainage and easy removal, and the gauze pack left in place for three days, obtaining maximum sclerosing effect and promoting a walling off process and drainage to the outside. Then the gauze is removed, after accomplishing its purpose.

FIG. 1. Photograph taken six months after surgery.

CASE REPORT

A white female, aged sixty, had a walnut-size cystic tumor mass in the middle of the neck, just below the hyoid bone, which had appeared within the past six months. She complained of sticking pain in the neck, slight difficulty in swallowing solid foods, and a foul taste in

* Dr. Francis M. Lyle is now a Captain in the Medical Corps, U. S. A., and is stationed at Station Hospital, Wendover Field, Utah.

the mouth. A diagnosis of thyroglossol duct cyst was made from history and findings.

At operation, the cyst extended about the trachea below the hyoid bone. Due to the thin wall of the cyst, which contained a foul smelling serous oily fluid, and its investment about the trachea, we selected what we think is a new method of treating cystic tumors. We filled the cavity with one-inch gauze impregnated with 8 cc. of sodium morrhuate solution. We brought the gauze out through the skin incision and approximated the skin loosely about the drain. Hot packs were used every three hours postoperatively. On the third day the gauze was removed. The patient stated she tasted a soapy solution down in the throat.

On the fifth day the stitches were removed and approximately 5 cc. of serous fluid was removed. No more fluid accumulated and the neck healed primarily with good cosmetic results. Six months after operation there was no sign of recurrence.

In the first half of the fifteenth century several eminent physicians dealt with gynaecology. The best résumé of mediaeval gynaecology was written by Nicolò Falcucci (?–1412?) in the early part of the fifteenth century. There is a reference to a certain woman, Andrea Salsito, who lived many years after the removal of a prolapsed uterus. Falcucci likewise opened the abdominal cavity at the umbilical area and extracted foetal bones of an old abdominal pregnancy.

INTESTINAL OBSTRUCTION DUE TO GALLSTONE

L. M. RANKIN, M.D. AND SHERMAN A. EGER, M.D.
Chief of Service, Delaware County Hospital — Assistant Surgeon, Delaware County Hospital
UPPER DARBY, PENNSYLVANIA

AFTER reviewing the literature, Angle[1] found that the first case of intestinal obstruction due to a gallstone was reported by Bartholin in 1654. In an analysis of 8,108 cases of intestinal obstruction, from all causes, Balch[2] discovered that 142 were due to gallstone or an incidence of 1.7 per cent, which indicates that this condition is uncommon, rather than rare. Furthermore, the vast majority of these cases, about 90 per cent, occurred in women in the later decades of life. Snyder[3] states that "the mortality attending surgical intervention in these cases, whether the specific cause of the obstruction is predetermined or not, is between 60 and 70 per cent." This makes one realize the seriousness of the problem at hand when this condition is encountered.

There are several factors which contribute to this high mortality: (1) Obesity; (2) poor operative risks because of the various generalized degenerative changes incident to old age; (3) delay in operation because of improper diagnosis. A flat plate *x*-ray of the abdomen should be made in all cases because the obstructing stone usually can be visualized. Rigler, Borman and Noble[4] state that in thirteen of their fourteen cases of gallstone obstruction in which roentgen examination was made, the exact diagnosis could have been made from the roentgenograms alone. (4) Improper preoperative treatment because of insufficient understanding of the pathological process at the site of obstruction. Because of the rapidity with which the impacted gallstone ulcerates through the intestinal wall, with resulting peritonitis, it is imperative that operative removal of the offending stone be done without delay. Therefore, it is very hazardous to wait for decompression by suction therapy before operating. If suction decompression is necessary for safe surgical intervention, it can be started while the patient is being prepared, and continued during and after the operation.

The treatment consists in early operation with removal of the obstructing stone. It is advisable to push the stone proximally or distally, whichever is easier, to a healthy area of the intestine for removal. If the stone is too firmly fixed for this procedure, it can usually be safely dislodged by invaginating the stone and attached bowel into the proximal and distended portion. As this is accomplished the wall of the intestine attached to the stone gradually peels off. The following three cases illustrate these points.

CASE REPORTS

CASE 1. A. L., an obese female, age seventy-seven, was admitted the morning of June 5, 1936, with a diagnosis of acute abdominal condition. The night previous to admission the patient was very restless for several hours and then suffered a severe attack of generalized abdominal pain about 4 A.M. followed by nausea and vomiting. During the morning four paroxysmal attacks of severe upper abdominal pain were superimposed upon the generalized pain that had been continuous. Nausea and vomiting followed each attack.

The patient was jaundiced at the age of twenty-five for about ten days. Three years ago, she had an attack of upper abdominal pain, lasting two to three weeks, and diagnosed as gallstones.

Examination revealed an obese abdomen without distention. There was rigidity and deep tenderness just above and to the right of the umbilicus but no abnormal masses were palpable. Her temperature was 100°F., pulse 108, respiration 24, blood pressure 170/100, white blood cells 12,400. Urinalysis showed a trace of albumin. A portable flat plate of the

abdomen was not helpful. The preoperative diagnosis was intestinal obstruction.

Operation was performed two hours after admission. On opening the abdomen through an upper right rectus incision, a small amount of serosanguineous free fluid was encountered, culture of which was negative. The jejunum was free but completely obstructed about twelve inches from the ligament of Treitz by a hard round object in its lumen. Because of its impaction, this object was pushed proximally for several inches, using the method described above, and here removed through an incision in the wall of normal jejunum. Dense adhesions around the gallbladder were left undisturbed. The abdomen was closed without drainage. The object removed was a gallstone shown in Figure 1. Postoperative progress was very satisfactory until the ninth day when signs of cardiac failure began and progressed in spite of treatment by the medical department, resulting in death on the thirteenth day. Autopsy was refused.

FIG. 1. Impacted gallstone removed from jejunum in Case I.

CASE II. A. M., an obese female, age fifty-nine, was admitted at 5:30 P.M. December 22, 1940, with a diagnosis of acute appendicitis. About ten hours previous to admission, without any prodromal symptoms, the patient developed an attack of severe generalized abdominal pain while eating breakfast, followed immediately by vomiting. From then on to admission paroxysmal attacks of pain and nausea with some vomiting occurred, numbering about fifteen.

For the past several years she had experienced mild indigestion with belching, but without severe pain, nausea or vomiting.

FIG. 2. Impacted gallstone removed from jejunum in Case II.

Examination revealed evidence of dehydration and an obese abdomen without distention. There was rigidity in the right upper quadrant and the point of acute tenderness was just above and to the right of the umbilicus. No abnormal masses were palpable. Her temperature was 99°F., pulse 108, respiration 24, blood pressure 130/70, hemoglobin 98 per cent, red blood cells 5,300,000, white blood cells 19,400, 84 per cent polymorphonuclears, stabs 40, seg. 44. Urinalysis showed a specific gravity of 1.018, and a moderate trace of albumin, otherwise it was negative. The impression was high intestinal obstruction.

Dehydration was combatted by parenteral fluids before, during and after operation. One hour after admission the abdomen was opened through an upper right rectus incision. Free serosanguineous fluid was present in a large amount, culture of which was negative. The jejunum was free but completely obstructed about eighteen inches from ligament of Treitz, by a firm, round object in its lumen. Three inches proximal to the point of obstruction, there was an area in the jejunum where the object must have previously been lodged, because of its bulbar dilatation, thinned wall, and three points of pressure necrosis which had not perforated. The normal appearance of the jejunal wall over the obstructing object justified the conclusion that migration distally had just occurred. Therefore, the object was removed at this point and found to be a gallstone as

shown in Figure 2. The omentum was sutured over the bulbus, necrotic area of jejunum described above. Dense adhesions about the gallbladder were left undisturbed. The patient made an uneventful postoperative recovery and was discharged on the twenty-fourth day. There has been no recurrence of symptoms.

Case III. E. D., an obese female, age seventy-two, was admitted to medical service January 7, 1942, with a diagnosis of partial intestinal obstruction. She had been well until three days before when she developed severe pain over the entire abdomen, but chiefly at the umbilicus, associated with nausea and vomiting. These symptoms markedly improved during the twelve hours previous to admission, until she was able to retain liquids and soft foods. Her bowels had not moved for three days but an enema after admission was very effective for gas and feces. A large umbilical hernia was present for many years without symptoms.

Examination revealed no evidence of dehydration. The abdomen was obese without distention. The large umbilical hernia would completely reduce on lying down. No tenderness or rigidity and no abnormal masses were palpable. Her temperature was 98°F., pulse 74, respiration 20, blood pressure 190/90, white blood cells 8,400, normal differential and Schilling. Urinalysis showed a specific gravity of 1.028; sugar negative, a moderate trace of albumin, occasional hyaline and fine granular casts. Blood sugar was 110 mg., urea nitrogen 40, creatine 1.5. Wassermann and Kahn tests were negative.

On January 8th she was seen by one of us in consultation and a provisional diagnosis of partial intestinal obstruction related to long standing umbilical hernia was made. This was to be verified by *x*-ray study of the gastrointestinal tract. The evening of the following day pain, nausea and vomiting returned and the abdomen became distended. By early the next morning, January 10th, the patient had responded sufficiently to parenteral fluids and syphon suction decompression for operation. At operation a large gallstone, shown in Figure 3, was found at the ileocecal junction causing complete obstruction. The stone was pushed proximally according to the method described above and removed. Evidence of pressure necrosis was absent. There was no other evidence of obstruction. Adhesions about the gallbladder were not disturbed and the hernia was not repaired. The abdomen was closed without drainage. The postoperative convalescence was uneventful and the patient was discharged nineteen days later. There has been no recurrence of symptoms.

Fig. 3. Impacted gallstone removed from ileocecal junction in Case III.

SUMMARY

1. Three cases of intestinal obstruction due to gallstones are reported.

2. All three were obese females, ages seventy-seven, fifty-nine and seventy-two years of age, respectively.

3. The exact cause of the obstruction was not diagnosed preoperatively in any case. *X*-ray (abdominal flat plate) was made in only one case and this was not satisfactory.

4. The site of the obstruction was high in the jejunum in two cases and at the ileocecal junction in one.

5. Pressure necrosis was present in only one case.

6. The obstructing stone, varying in size from 2 ½ to 4 cm. in diameter, was removed in all three cases.

7. Two cases recovered and have had no recurrence of symptoms. One death, age seventy-seven, was due to cardiac failure on the thirteenth day following operation.

CONCLUSIONS

1. Gallstone obstruction of the intestinal tract is uncommon but not rare.

2. Failure in diagnosis, preoperatively, may be minimized by a flat plate *x*-ray of the abdomen properly taken and carefully interpreted.

3. Immediate operation is the procedure of choice when the obstruction is complete in order to avoid pressure necrosis of the intestinal wall by the impacted stone.

4. The mortality is high even in the uncomplicated cases due chiefly to the usually advanced age of the patients.

REFERENCES

1. Angle, L. W. Acute intestinal obstruction caused by impacted gallstones. *Am. J. Surg.*, 17: 364–368, 1932.
2. Balch, F. G., Jr. Gallstone ileus. *New England J. Med.*, 218: 457–462, 1938.
3. Snyder, L. H. Unrecognized gallstone obstruction of the intestine. *South. M. J.*, 31: 1275–1276, 1938.
4. Rigler, L. G., Borman, C. N. and Noble, J. F. Gallstone obstruction. *J. A. M. A.*, 117: 1753–1759, 1941.

Johann Weyer (1515–1588), a famous demonologist, was also a capable physician and surgeon. In his *Observationum Medicarum Rararum* he reported in detail the technique for incising an imperforate hymen, and the use of lead or silver tubes to distend the vagina and maintain drainage. The incision might be either oblique, transverse or crucial.

New Instruments

INTESTINAL CLAMPS*

A NEW STRUCTURAL PRINCIPLE

EDGAR J. POTH, M.D.
Attending Surgeon, John Sealy Hospital
GALVESTON, TEXAS

MANY intestinal clamps have been described, but usually these instruments are modifications of older types of clamps and seldom include new principles either mechanical or functional. Stone,[1] in 1937, and Owings and Stone, in 1939,[2] described a clamp which incorporated a new principle: a hinged clamp closed at the open end by a second instrument.

All crushing clamps cause considerable damage not only to the tissue under the jaws of the clamp but to the bowel in the immediate vicinity of the jaws as well. The tissue under the jaws is forced laterally in both directions into the walls of the contiguous bowel. The extent of the damage done to the wall of the bowel in the immediate region where the intestinal suture is to be placed depends upon the quantity of this displaced crushed tissue.

It is not the purpose of this note to describe a new intestinal clamp, but rather to present a new principle which can be applied to many of the existing designs of gastrointestinal clamps. The principle consists merely in using beveled blades instead of blades with parallel surfaces for the jaws of the clamps (Fig. 1 A and B.) When a clamp having beveled blades crushes the wall of the bowel, the included tissue is squeezed toward the open edge of the bevel (Fig. D.) Since the clamp is applied with the approximating edges of the beveled jaws facing the region where the suture is to be placed, the tissue traumatized by the blades is forced toward the edge of the clamp against which the bowel is to be resected (Fig. 1 D and E.)

The tissue included in the jaws of the clamp (Fig. 1 B, D, and E) is desiccated with the hot cautery to form a hard, dry wedge which will not pull through the jaws of the clamp. Although the total width of the jaws of the clamp may not exceed 2.5 mm., the end of the bowel is always securely held.

REFERENCES

1. STONE, H. B. Method of intestinal anastomosis with a new clamp. *Surg., Gynec. & Obst.*, 65: 383, 1937.
2. OWINGS, J. C. and STONE, H. B. Technique of anastomosis using the stone clamp. *Surg., Gynec. & Obst.*, 68: 05, 1939.

* From the Department of Surgery, The Johns Hopkins University School of Medicine, Baltimore.

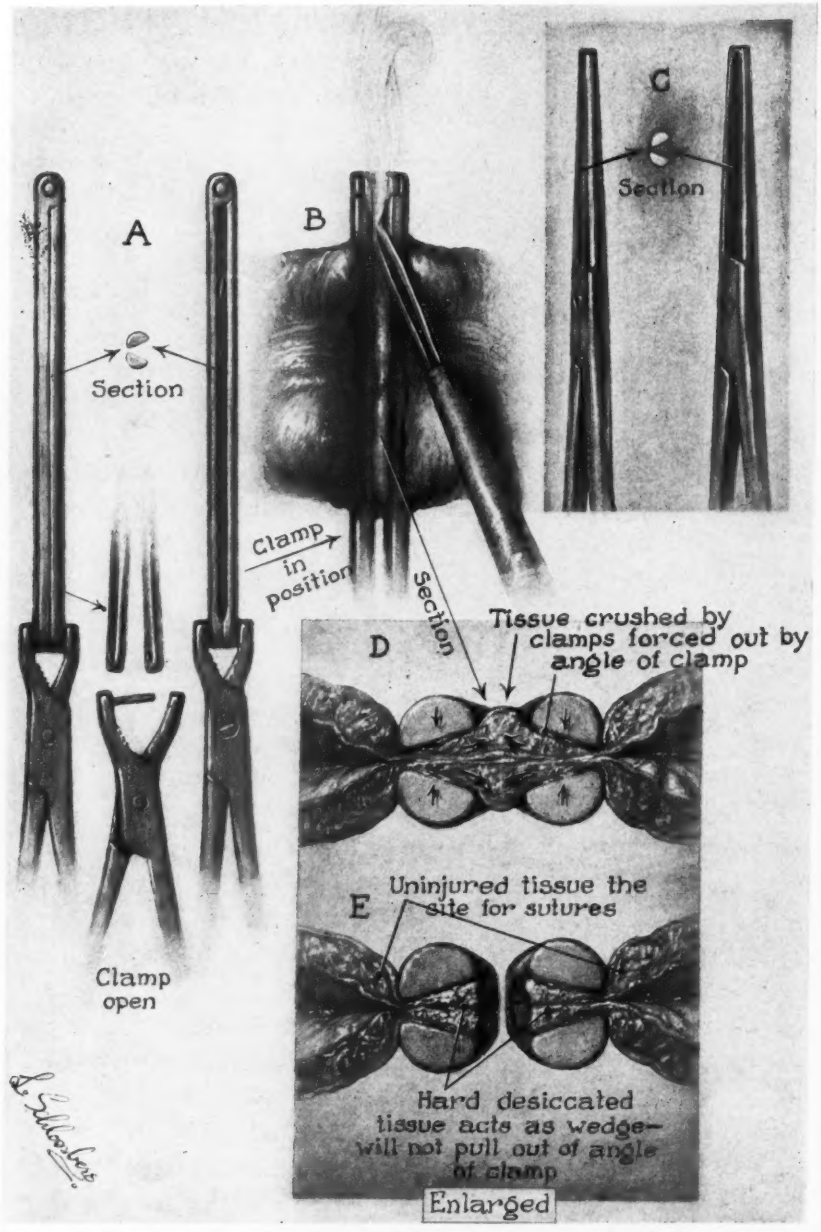


FIG. 1. A demonstration of a new principle in the design of the blades of intestinal clamps. A, illustrates the principle of the beveled blades applied to the Stone clamp. B, shows the clamps in place and resection by cautery. C, illustrates the same principle applied to a simple Kocher clamp. D, demonstrates the manner in which the tissue crushed under the blades of the clamp is forced away from the site of subsequent suture to avoid damaging this vitally important region. E, shows the narrow wedge of hard desiccated bowel included in the clamp which prevents the end of the viscus from pulling out of the instrument.

MODIFICATION OF THE RED CROSS WOODEN TRACTION SPLINT

FIRST LIEUT. JOSEPH ESTRIN, M.C.
59th Station Hospital
LOS ANGELES, CALIFORNIA

IN my experience teaching American Red Cross First Aid, I have come to appreciate greatly the use of the wooden traction splint.

The method of application of this splint, as outlined in the Red Cross First Aid Text Book (as applied to the lower extremity) is as follows: (1) Manual traction is applied to the foot, with countertraction on the body. (2) A cravat bandage is placed around the ankle in a traction hitch. (3) Another cravat bandage is placed with its center in the crotch of the injured leg, the ends being tied in a square knot around the upper thigh to form a loose loop above the hip. (4) One notched end of the wooden traction splint is placed against the loop of this latter cravat bandage. (5) The ends of the traction hitch on the ankle are then pulled over the notch on the other end of the splint and tied in a square knot. (6) A short stick is inserted in this last area and used as a Spanish windlass to make traction upon the ankle. (7) Several broad cravats are then applied around the leg and board from ankle to the upper thigh.

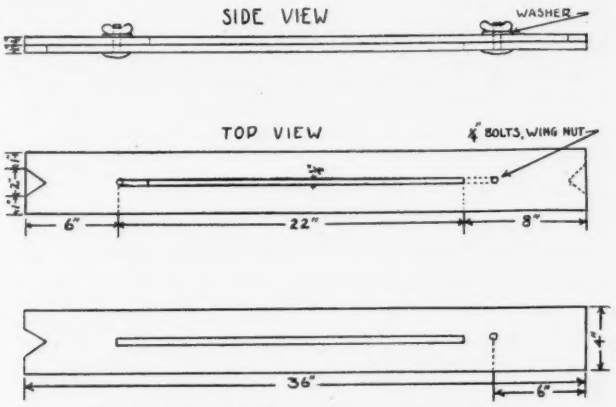


FIG. 1. Adjustable wooden traction splint.

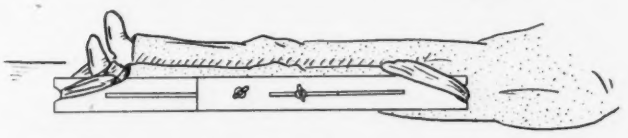


FIG. 2. Diagram of splint on lower extremity.

The splint consists essentially of two long flat boards, light in weight, and exactly similar in construction, with a notch at one end of each board to receive the bandage, and held together by two wing nut bolts through opposing drill holes in the boards. The size of the splint can be varied by placing the bolts in the several other drill holes in the boards.

In working with this splint, I have been impressed with the fact that a slight change in its construction would greatly facilitate its use. The modification I have to suggest is the placing of a slot in the center of each board, running to within several inches of the ends of the boards. (Fig. 1.) The bolts, anchored through drill holes in only one

of the boards, fit into the slot of the other board, so that, when the wing nut is loosened, the size of the boards can be readily adjusted. This change is made for several apparent reasons: It makes it a simple procedure to vary rapidly the size of the splint to fit any upper or lower extremity. In addition, after fitting the cravat bandages in place, the splint is applied and sufficient traction made upon the boards. The wing nuts are then rapidly tightened, maintaining this traction without any further procedure. (Fig. 2.) This method of application permits the uninterrupted manual traction of the extremity by the assistants throughout the process of the application of the splint. It also eliminates the use of the Spanish windlass for traction.

This method can rapidly be taught to first aiders. The materials necessary are readily available and are most inexpensive. Its simplicity and yet extreme effectiveness in emergency work make this modification of the splint a valuable adjunct.

A STRANGE reference to an anteverted uterus appeared in the literature of the eighteenth century. The famous French *accoucheur*, levret, in 1783, stated that the fundus of an anteverted uterus was mistaken for a bladder calculus, and the patient died from the effects of lithotomy performed because of this erroneous idea. In this instance it was stated that slight engorgement of the anterior wall of the fundus and a somewhat unusual shortening of the round liagments were considered the causes of the malposition.

The brief excerpts in this issue have been taken from "The Genealogy of Gynaecology" by James V. Ricci, M.D. (The Blakiston Company).

AUTHOR INDEX TO VOLUME LXI

Adams, Payson, 316
Allen, Frederick M., 79
Alley, John L., 117

Bachhuber, C. A., 308
Barrett, Henry A., 42
Beneventi, Francis A., 244
Billow, Bennett W., 128
Bisgard, J. Dewey, 425
Bodkin, Laurence G., 277
Brunkow, Ben H., 394
Bunch, George H., 280
Burman, Michael, 167
Busch, Irving, 54

Campbell, Meredith F., 99
Capone, A. J., 387
Carlucci, G. A., 271
Case, Thomas C., 107
Cave, W. H., 305
Cetrulo, Gerald I., 93
Cochran, R. M., 425
Cohn, Isidore, 61
Coleman, Frank C., 126
Conley, John J., 266
Connally, Eugene F., 154
Crecca, William D., 93

DeCourcy, Joseph L., 11
Doran, William T., 136
Doran, William T., Jr., 136
Drummond, Alvin C., 286
Dunlap, Harold J., 266

Eckes, William P., 291
Eger, Sherman A., 300, 445
Estrin, Joseph, 451

Ficarra, Bernard J., 121
Fobes, Joseph H., 99
Foster, George C., 2

French, Edison A., 16

Glasser, S. Thomas, 291
Gold, Herman, 310
Goldman, Charles, 430
Gradinger, Billens C., 297
Graney, Charles M., 112

Harkins, Henry N., 67
Hecht, Emanuel L., 150
Horwitz, Moris, 132
Howser, John William, 421
Hyams, Joseph A., 117

Jacobson, Charles E., Jr., 224

Komora, Edward J., 380
Kruger, Alfred L., 138

Laird, William R., 418
Lyle, Francis M., 148, 443
Lynch, Jerome Morley, 360

Maar, Henry R., 150
Mackler, Harry, 439
Mahoney, Louis E., 414
Maliniac, Jacques W., 313
Massell, Theodore B., 434
McLaughlin, Edward Francis, 124
Mersheimer, Walter L., 291

Newerla, Gerhard J., 154
Nolan, Lewis E., 418

Pack, George T., 215
Pearce, Alexander E., 76
Pearman, Robert O., 423
Peterson, Edward W., 350
Poth, Edgar J., 449
Potter, Irving W., 159
Potter, Milton G., 159
Pratt, Gerald H., 1

Priestley, James T., 38
Puderbach, Walter J., 121

Quattlebaum, Julian, 280

Rankin, L. M., 300, 445
Rebbeck, E. W., 259
Rigdon, R. H., 407
River, Louis P., 297
Robillard, Gregory L., 430
Root, Grosvenor T., 38

Sano, Machteld E., 105
Saypol, George M., 103
Schenken, John R., 126
Serino, G. Samuel, 400
Shapiro, Morris J., 132
Sheehan, J. Eastman, 324, 331, 339
Sheinfeld, William I., 439
Sommer, George N. J., Jr., 266
Spencer, James H., Jr., 249
Spivack, Abraham H., 54
Sutton, Leon E., 239
Swan, Henry, 3
Swartzel, Karl D., Jr., 215

Tepper, Gilbert B., 434
Thompson, Gershom J., 224
Tripodi, Antonio M., 138
Tyler, Albert F., 302

Vandergriff, Harris, 407

Wagner, R. F., 271
Weber, John J., 143
Wehrbein, Heinrich L., 143
Weinberg, Sidney R., 117
Winter, Leo, 367
Wollner, Anthony, 157

Zabrinski, Edward J., 67

SUBJECT INDEX TO VOLUME LXI

(Bo. B.) = Bookshelf Browsing; (E.) = Editorial

Abscess
  appendiceal, 297
  perinephric, in infants and children, 3
Anatomy, inguinofemoral, 380
Anesthesia
  local (E.), 1
  pentothal sodium oxygen, 16
Aneurysms of coronary arteries, 407
Anuria, sulfadiazine, 99
Appendicitis
  acute, suppurative, 249
  and schwannomas, 418
  gangrenous, 154
Appendix, stones in, 138
Appliance, Roger Anderson, 367
Art of local anesthesia (E.), 1
Arteries, coronary, aneurysms of, 407
Asepsis and tetanus, 280
Aspects
  for inguinal herniorrhaphy, 380
  surgical, of cholecystitis, 38
Auricles, cervical, 266

Baseball finger, repair of, 103
Bacillus welchii infection of prostate, 286
Balance of hand muscles, 167
Blood irradiation, 259
Body, perineal, removal of, 302
Bone marrow and fat embolism after fracture of femur, 126
Breast, osteochondrofibrosarcoma of, 271
Burn, mangle, 148
Burns as war wounds, 331

Carcinoid of stomach, 121
Casualties, war, and plastic surgery, 239
Cecitis, phlegmonous, 54
Cecostomy, McNealy, 421
Children, perinephric abscess in, 3
Cholecystitis, acute, 38
Clamps, intestinal, 449
Crecca-Cetrulo guide, 93
Cysts
  congenital, 350
  ovarian, and pregnancy, 387

Demonstration of pneumoperitoneum and diaphragmatic irritation, 76
Diagnosis
  of pelvic disorders, 394
  of perforated ulcer, 76
Dilatation, retrograde, for hydrocalyx, 244
Disorders, pelvic, diagnosis of, 394
Duodenum, sarcoma of, 425
Dysfunction, neurogenic vesical, 224

Embolism, fat, after fracture of femur, 126
Endocarditis after skull fracture, 150
Epithelioma, squamous cell, of vulvae and perineal body, 302
Evaluation of McNealy cecostomy, 421
Extraction and podalic version, 159

Femur
  blind nailing of, 93
  fracture of, bone marrow and fat embolism after, 126
Fibromyoma, pedunculated, of inguino-abdominal region, 308
Finger, baseball, repair of, 103
Fistula
  appendiculocolic, 297
  congenital, 350
  gastrojejunocolic, 434
Fixation appliance, skeletal, 367
Fluid administration in shock, 79
Fogging of spectacles (E.), 2
Fracture
  of femur, bone marrow and fat embolism after, 126
  of mandible, 367
  of skull, 150

Gallbladder, perforation of, 300
Gallstone
  ileus, 439
  obstruction of intestine by, 445
Gastrectomy, subtotal, for carcinoid of stomach, 121
Grafting
  of skin, 105
  of tissue, 339

Hand, kinetic disabilities of, 167
Hemo-irradiation, 42
  preoperative, 259
Hemorrhage, delayed, from ruptured spleen, 124
Hepatoma, malignant, 430
Hepatomegaly and splenomegaly, 128
Hernia, femoral, and appendicitis, 154
Herniorrhaphy, inguinal, 380
Hospital, rural, appendicitis at, 249
Hydrocalyx, 244
Hyperthyroidism of juvenile familial type, 291

Ileitis, chronic, and ureteritis, 117
Ileus, gallstone, 439
Infants, perinephric abscess in, 3
Infection, Bacillus welchii of prostate, 286
Inflammation of cecal wall, 54
Injuries, mangle burn, 148
Intestine
  clamp for, 449
  obstruction of, 445
Irritation, pneumoperitoneum and diaphragmatic, 76

Juvenile hyperthyroidism, 291

Kidney, rupture of, 316
Kinetic disabilities of hand, 167
Knott technic, 42, 259
Know your patient, 360

Lesions
  cervical, of branchial origin, 266
  malignant, multiple, 143
Lithiasis, appendiceal, 138
Lymphosarcoma of stomach with perforation, 136

Management
  of appendicitis in rural hospital, 249
  of gastrojejunocolic fistula, 434
Mandible, fractures of, 367
Mangle burn injuries, 148
Materials for sutures, 414
McNealy cecostomy, 421
Medicine, Soviet (Bo. B.), 310
Meningitis, pneumococcic, and endocarditis after skull fracture, 150
Mesentery, sarcoma of, 132
Modification of red cross wooden traction splint, 451
Morphine sulfate, use of, 423
Motion pictures, surgical, 215
Muscles, of hand, balance of, 167
Myelodysplasia and vesical dysfunction, 224

Nailing, blind, of femur, 93
Neck
  tumors of, 350
  vesical, resection of, 224
Neurofibromatosis, Von Recklinghausen's, 128

Obstruction
  intestinal, due to gallstone, 445
  pyloric, caused by gallstone, 439
Operation
  for pilonidal sinus, 61
  Whipple, 425
Osteochondrofibrosarcoma of breast, 271
Ovary, cysts of, 387

Patient, the, 360
Pelvis, disorders of, 394
Pentothal sodium oxygen in surgery, 16
Perforation
  and lymphosarcoma of stomach, 136
  spontaneous, of gallbladder, 300
Photography, stereoscopic, for surgical motion pictures, 215
Plastic surgery for war casualties, 239
Postwar medical problems (E.), 157
Pregnancy and ovarian cysts, 387
Priapism, 305
Problems, postwar, medical, economic (E.), 157
Prostate, Bacillus welchii infection of, 286

Rectum, stricture of, 277
Red cross traction splint, 451
Region, inquino-abdominal, fibromyoma of, 308
Reidel's thyroiditis, 107
Removal of vulvae and perineal body, 302
Resection
  gastric, 136
  transurethral, of vesical neck, 224
  with head of pancreas for sarcoma of duodenum, 425
Richter's hernia and appendicitis, 154
Roger Anderson appliance, 367
Rupture
  bilateral, of quadriceps femoris tendons, 112
  traumatic, of kidney, 316
    of spleen, 67

Sarcoma
  neurogenic of mesentery, 132
  of duodenum, 425
Schwannomas in appendicitis, 418
Shock, therapy of, 79
Significance of schwannomas, 418
Sinus, pilonidal, operation for, 61
Sinuses, cervical, 266
Skin grafting, 105
Skull, fracture of, 150
Soviet medicine (Bo. B.), 310
Spectacles, fogging of (E.), 2
Spina bifida and vesical dysfunction, 224
Spleen
  rupture of, 67
  ruptured, and hemorrhage, 124
Splenomegaly, 128
Splint, traction, 451
Status of gastric and duodenal ulcer, 11
Stomach
  carcinoid of, 121
  lymphosarcoma of, 136

Stone in appendix, 138
Stricture of rectum, 277
Sulfadiazine anuria, 99
Sulfathiazole in surgery, 400
Surgery
  major, anesthesia in, 16
  plastic, for war casualties, 239
    in war (E.), 313
  sulfathiazole in, 400
Suture materials, 414

Technic
  for nailing of femur, 93
  for repair of baseball finger, 103
  Knott, 42, 259
  of podalic version and extraction, 159
Tendons, quadriceps femoris, rupture of, 112
Tetanus, postoperative, 280
Theory and therapy of shock, 79
Thyroiditis, Reidel's, 107
Tissue
  culture and skin grafting, 105
  grafting, 339
Traction splint, 451
Treatment of cystic tumors, 443
Tumors
  cystic, treatment of, 443
  of neck, 350

Ulcer
  gastric and duodenal, 11
  perforated, diagnosis of, 76
Ureteritis and ileitis, 117
Ureteropyelostomy for anuria, 99
Use, intravenous, of morphine sulfate, 423
Uterography, 394

Version, podalic, 159

Von Recklinghausen's neurofibromatosis, 128
Vulvae, removal of, 302

War
  burns sustained in, 331
  casualties and plastic surgery, 239
  organization of plastic surgery (E.), 313
  wounds, 324
Whipple operation, 425
Wounds, war, 324

The American Journal of Surgery

PUBLISHED MONTHLY BY THE AMERICAN JOURNAL OF SURGERY, INC.
49 WEST 45TH STREET, NEW YORK 19, N. Y.

Editor: THURSTON SCOTT WELTON, M.D., NEW YORK

EDITORIAL BOARD

FRED H. ALBEE, *N.Y.*; CARL BECK, *Chicago*; CLAUDE S. BECK, *Clev.*; GEO. R. BRIGHTON, *N.Y.*; MEREDITH F. CAMPBELL, *N.Y.*; JAMES T. CASE, *Chicago*; ISIDORE COHN, *N.O.*; BRADLEY L. COLEY, *N.Y.*; FREDERICK A. COLLER, *Ann Arbor*; PAUL C. COLONNA, *Phila.*; ELLIOTT C. CUTLER, *Boston*; CHARLES A. ELSBERG, *N.Y.*; HERBERT C. FETT, *Brooklyn*; JOHN H. GIBBON, *Phila.*; EMIL GOETSCH, *Brooklyn*; CHARLES A. GORDON, *Brooklyn*; DONALD GUTHRIE, *Sayre, Pa.*; A. E. HERTZLER, *Kansas City*; LOUIS J. HIRSCHMAN, *Detroit*; J. M. HITZROT, *N.Y.*; FREDERICK C. HOLDEN, *N.Y.*; EMILE F. HOLMAN, *San Francisco*; JOHN E. JENNINGS, *Brooklyn*; W. L. KELLER, *Washington*; T. J. KIRWIN, *N.Y.*; ARTHUR KRIDA, *N.Y.*; A.V.S. LAMBERT, *N.Y.*; MAURICE LENZ, *N.Y.*; H. H. LYLE, *N.Y.*; JEROME M. LYNCH, *N.Y.*; URBAN MAES, *N.O.*; HARRISON S. MARTLAND, *Newark, N.J.*; RUDOLPH MATAS, *N.O.*; ROY D. MCCLURE, *Detroit*; H. C. NAFFZIGER, *San Francisco*; EMIL NOVAK, *Balt.*; CLARENCE R. O'CROWLEY, *Newark, N.J.*; LOUIS E. PHANEUF, *Boston*; EUGENE H. POOL, *N.Y.*; JAMES T. PRIESTLEY, *Rochester, Minn.*; DOUGLAS QUICK, *N.Y.*; N. P. RATHBUN, *Brooklyn*; HUBERT A. ROYSTER, *Raleigh*; HENRY S. RUTH, *Phila.*; M. G. SEELIG, *St. Louis*; J. BENTLEY SQUIER, *N.Y.*; H. J. STANDER, *N.Y.*; GRANT E. WARD, *Baltimore*; J. H. WOOLSEY, *San Francisco*.

NEW SERIES, VOLUME LXI

JULY TO SEPTEMBER

1943

THE AMERICAN JOURNAL OF SURGERY · INC · PUBLISHERS
NEW YORK MCMXLIII

COPYRIGHT, 1943
BY THE AMERICAN JOURNAL OF SURGERY, INC.
All Rights Reserved

Printed in the United States of America

CONTENTS OF NEW SERIES, VOLUME LXI

ORIGINAL ARTICLES

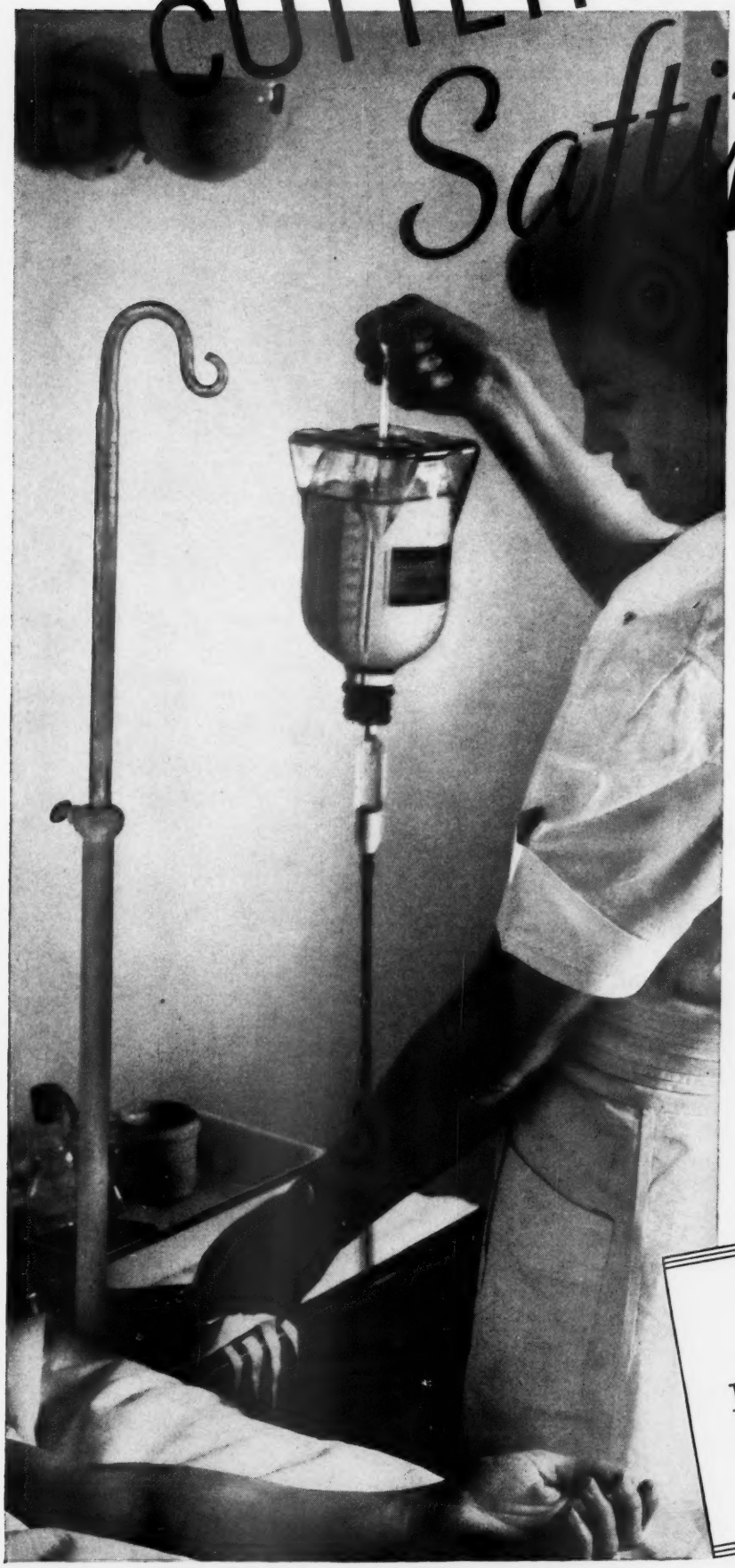
Perinephric Abscess in Infants and Children. A Study of Twenty-six Patients Surgically Treated	*First Lieut. Henry Swan*	3
Present Status of Gastric and Duodenal Ulcer	*Joseph L. DeCourcy*	11
Pentothal Sodium Oxygen Anesthesia in Major Surgery	*Edison A. French*	16
Acute Cholecystitis. Certain Pathologic and Surgical Aspects	*Grosvenor T. Root* *James T. Priestley*	38
Five Years' Experience with Hemo-irradiation According to the Knott Technic	*Henry A. Barrett*	42
Phlegmonous Cecitis. Report of Two Cases and Review of the Literature	*Abraham H. Spivack* *Irving Busch*	54
Operation for Pilonidal Sinus	*Isidore Cohn*	61
Traumatic Rupture of the Spleen. Experiences with Ten Cases in a General Hospital	*Henry N. Harkins* *Edward J. Zabinski*	67
Diagnosis of Perforated Ulcer. Two Useful Maneuvers by Means of Which Pneumoperitoneum and Diaphragmatic Irritation Are Demonstrated More Clearly	*Capt. Alexander E. Pearce*	76
Theory and Therapy of Shock. Excessive Fluid Administration	*Frederick M. Allen*	79
Improved Technic for Blind Nailing of the Neck of the Femur. The Crecca-Cetrulo Guide	*William D. Crecca* *First Lieut. Gerald I. Cetrulo*	93
Sulfadiazine Anuria. Its Relief by Ureteropyelostomy	*Meredith F. Campbell* *Joseph H. Fobes*	99
Technic for the Repair of "Baseball" Finger	*George M. Saypol*	103
Skin Grafting. A New Method Based on the Principles of Tissue Culture	*Machteld E. Sano*	105
Reidel's Thyroiditis. Report of Two Cases	*Thomas C. Case*	107
Bilateral Rupture of Quadriceps Femoris Tendons with Six-year Interval between Injuries	*Charles M. Graney*	112
Chronic Ileitis with Concomitant Ureteritis. Case Report	*Joseph A. Hyams* *Sidney R. Weinberg* *John L. Alley*	117
Malignant Carcinoid of the Stomach. Case Report of a Patient Treated by Subtotal Gastrectomy	*Walter J. Puderbach* *Bernard J. Ficarra*	121

Secondary or Delayed Hemorrhage from a Ruptured Spleen. Case Report	*Major Edward Francis McLaughlin*	124
Bone Marrow and Fat Embolism Following Fracture of the Femur	*John R. Schenken* *Frank C. Coleman*	126
Von Recklinghausen's Neurofibromatosis. A Case of Hepatomegaly and Splenomegaly	*Bennett W. Billow*	128
Solitary Neurogenic Sarcoma of the Mesentery. Review of the Literature and Report of a Case	*Morris J. Shapiro* *Moris Horwitz*	132
Lymphosarcoma of the Stomach with Perforation. Gastric Resection with Recovery	*William T. Doran* *William T. Doran, Jr.*	136
Appendiceal Lithiasis	*Col. Antonio M. Tripodi* *Alfred L. Kruger*	138
Multiple Primary Malignant Lesions. Two Case Reports	*Heinrich L. Wherbein* *John J. Weber*	143
Mangle Burn Injuries	*Francis M. Lyle*	148
Pneumococcic Meningitis and Endocarditis Following Fracture of the Skull	*Henry R. Maar* *Emmanuel L. Hecht*	150
Gangrenous Appendicitis in Femoral Hernia of Richter's Type	*Gerhard J. Newerla* *Eugene F. Connally*	154
Technic of Podalic Version and Extraction	*Irving W. Potter* *Milton G. Potter*	159
Kinetic Disabilities of the Hand and Their Classification. A Study in Balance and Imbalance of the Hand Muscles	*Michael Burman*	167
Stereoscopic Photography for Surgical Motion Pictures	*George T. Pack* *Karl D. Swartzel, Jr.*	215
Neurogenic Vesical Dysfunction Due to Spina Bifida and Myelodysplasia. Treatment by Transurethral Resection of the Vesical Neck	*Gershom J. Thompson* *Charles E. Jacobson, Jr.*	224
Plastic Surgery in the Treatment of War Casualties	*Leon E. Sutton*	239
Hydrocalyx. Its Relief by Retrograde Dilatation	*Francis A. Beneventi*	244
Management of Acute Suppurative Appendicitis in the Small Rural Hospital. A Report of One Hundred Consecutive Cases	*James H. Spencer, Jr.*	249
Preoperative Hemo-irradiations	*Lieut. Comdr. E. W. Rebbeck*	259
Cervical Lesions of Branchial Origin	*Major George N. J. Sommer, Jr.* *Capt. John J. Conley* *Major Harold J. Dunlap*	266
Osteochondrofibrosarcoma of the Breast. Case Report	*G. A. Carlucci* *R. F. Wagner*	271

Stricture of the Rectum	*Laurence G. Bodkin*	277
Postoperative Tetanus	*George H. Bunch* *Julian Quattlebaum*	280
Bacillus Welchii Infection of the Prostate and Its Treatment	*Alvin C. Drummond*	286
Hyperthyroidism of the Juvenile Familial Type	*William P. Eckes* *S. Thomas Glasser* *Walter L. Mersheimer*	291
Appendiculocolic Fistula. Case Report	*Major Louis P. River* *Lieut. Billens C. Gradinger*	297
Acute Spontaneous Perforation of the Gallbladder	*L. M. Rankin* *Sherman A. Eger*	300
Removal of Vulvae and Perineal Body because of Squamous Cell Epithelioma	*Albert F. Tyler*	302
Priapism. Case Report and Review of the Literature	*W. H. Cave*	305
Pedunculated Fibromyoma of the Inguinoabdominal Region. Case Report	*C. A. Bachhuber*	308
Soviet Medicine	*Herman Gold*	310
Traumatic Rupture of the Kidney	*Payson Adams*	316
War Wounds	*J. Eastman Sheehan*	324
Burns as War Wounds	*J. Eastman Sheehan*	331
Tissue Grafting	*J. Eastman Sheehan*	339
Tumors of the Neck. Special Reference to Congenital Cysts and Fistulas	*Edward W. Peterson*	350
Know Your Patient	*Jerome Morley Lynch*	360
Fractures of the Mandible. Report of Fifty Applications of the Roger Anderson Skeletal Fixation Appliance	*Leo Winter*	367
Inguinofemoral Anatomy. Aspects Significant for Inguinal Herniorrhaphy	*Edward J. Komora*	380
Ovarian Cysts Complicating Pregnancy	*A. J. Capone*	387
Uterography. An Aid in the Diagnosis of Gynecological Pelvic Disorders	*Ben H. Brunkow*	394
Sulfathiazole Therapy in General Surgery	*G. Samuel Serino*	400
Aneurysms of the Coronary Arteries. Review of the Literature and Report of a Case	*R. H. Rigdon* *Harris Vandergriff*	407
Suture Materials	*Louis E. Mahoney*	414
Significance of Schwannomas as a Factor in Obscure Cases of Appendicitis	*William R. Laird* *Lewis E. Nolan*	418
Evaluation of the McNealy Cecostomy	*John William Howser*	421
Intravenous Use of Morphine Sulfate	*Robert O. Pearman*	423

Primary Sarcoma of Duodenum. Resection with Head of Pancreas by One-stage Whipple Operation	*J. Dewey Bisgard* *R. M. Cochran*	425
Malignant Hepatoma. Case Report	*Gregory L. Robillard* *Charles Goldman*	430
Management of Gastrojejunocolic Fistula	*Gilbert B. Tepper* *Theodore B. Massell*	434
Gallstone Ileus. Pyloric Obstruction Caused by Gallstone	*William I. Sheinfeld* *Harry Mackler*	439
Method of Treating Cystic Tumors	*Francis M. Lyle*	443
Intestinal Obstruction Due to Gallstone	*L. M. Rankin* *Sherman A. Eger*	445
Intestinal Clamps. A New Structural Principle	*Edgar J. Poth*	449
Modification of the Red Cross Wooden Traction Splint	*First Lieut. Joseph Estrin*	451

CUTTER SOLUTIONS IN *Saftiflasks*



IF YOUR HOSPITAL IS UNDERSTAFFED AND OVERWORKED . . . . .

Save the time of those few well-trained technical workers you have left — switch today to Cutter Solutions in Saftiflasks!

They're safer solutions, to begin with. Subjected to every known tes — many of which only a biological laboratory is equipped to carry on.

And, these days especially, how you'll like the many time-saving, work-saving advantages of the Saftiflask itself!

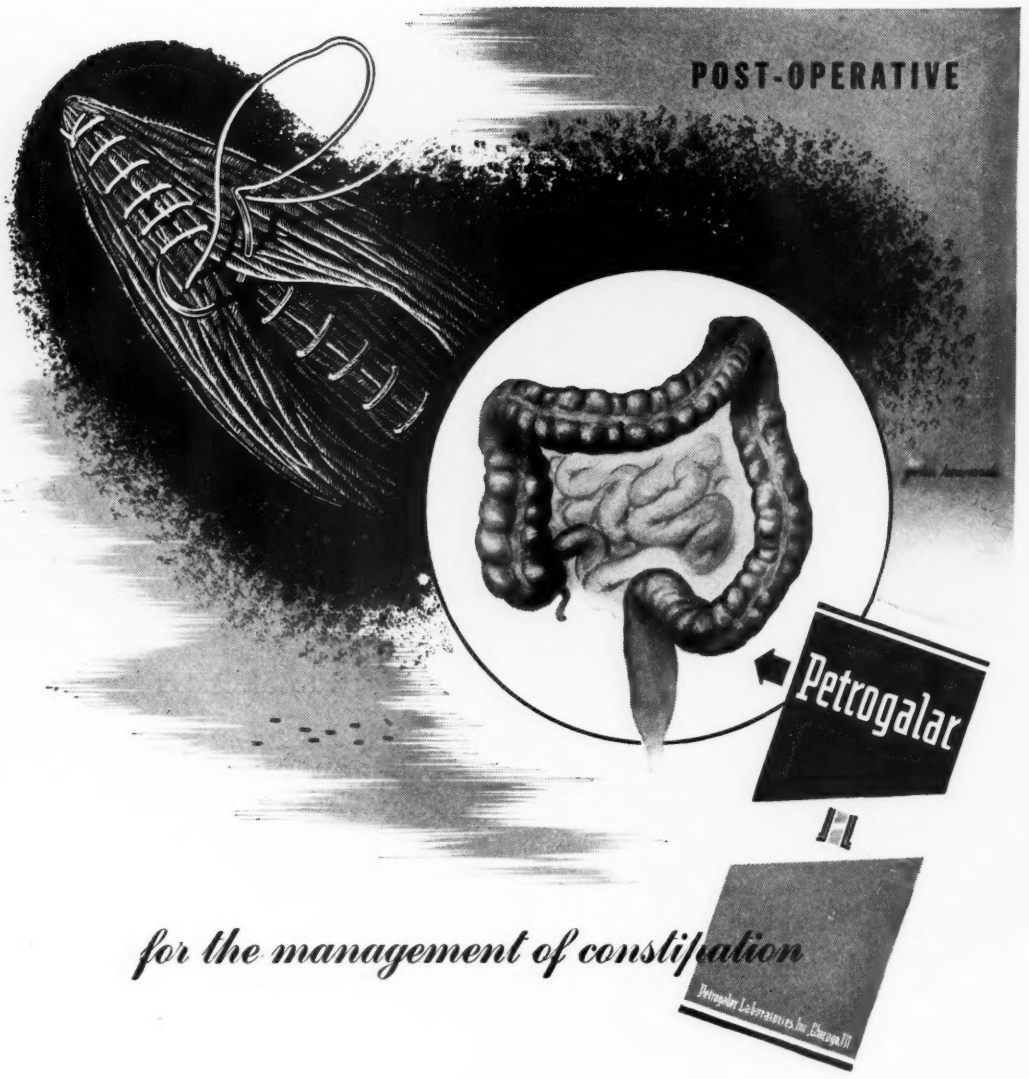
Here's real simplicity! No involved apparatus to present washing and sterilizing problems, particularly to the new worker. And even the Terrible Tempered Doctor Bang, who's all thumbs, can hook up the injection outfit with the flask — by just plugging the connecting tube into the hole in the stopper.

For simplicity and safety, say "Cutter!"

2
BIG ADVANTAGES

- A BIOLOGICAL LABORATORY'S SOLUTIONS
- IN TIME-SAVING, WORK-SAVING SAFTIFLASKS

CUTTER LABORATORIES . . . Berkeley, Chicago, New York



for the management of constipation

Restoration of Habit Time for Bowel Movement after surgery can be accomplished intelligently by the use of mild, efficacious Petrogalar.

After surgical interference, compensation for lack of exercise—gentle aid to tired intestinal muscles—easily gliding, painlessly motile bowel contents are requirements of importance.

Years of professional use have established Petrogalar as a reliable, efficacious aid for the restoration and maintenance of comfortable bowel action.

Petrogalar Laboratories, Inc.
8134 McCormick Blvd. Chicago, Illinois

PETROGALAR IS AN AQUEOUS SUSPENSION OF PURE MINERAL OIL EACH 100 CC. OF WHICH CONTAINS 65 CC. PURE MINERAL OIL SUSPENDED IN AN AQUEOUS JELLY.

COPYRIGHT 1943, BY PETROGALAR LABORATORIES, INC.

Petrogalar
REG. U.S. PAT. OFF.

Constant uniformity assures palatability—non-interference with secretion or absorption—normal fecal consistency. Five types of Petrogalar provide convenient variability for individual needs.

THE NUTRITIONAL STATE AND Surgical Hazards

The patient's ability to cope with the insult and trauma of inhalation anesthesia and surgical manipulation depends to a great extent upon his nutritional status.

The increased need for many essential nutrients during the postoperative period is an indication of this relationship. Hepatic function, so essential for rapid recovery, is also enhanced by increasing preoperative liver stores of proteins and vitamins, and by adequate postoperative feeding instituted as soon as tolerated.

The routine use of New Improved Ovaltine in presurgical preparation and in postoperative diets is a valuable aid in reducing the hazards of surgery and in hastening recovery. Its balanced composition supplies practically all the essential nutrients needed in greater amounts during the critical periods.

Readily digested and assimilated, this delicious food drink is well tolerated as soon as liquids are permitted, and releases its nutrients quickly for rapid utilization. The Wander Company, 360 North Michigan Avenue, Chicago, Illinois.

2 KINDS
PLAIN AND CHOCOLATE
FLAVORED

NEW IMPROVED
Ovaltine

Three daily servings (1½ oz.) of New Improved Ovaltine provide:

	Dry Ovaltine	Ovaltine with milk*		Dry Ovaltine	Ovaltine with milk*
PROTEIN . . .	6.00 Gm.	31.20 Gm.	COPPER	0.5 mg.	0.5 mg.
CARBOHYDRATE	30.00 Gm.	66.00 Gm.	VITAMIN A .	1500 U.S.P.U.	2953 U.S.P.U.
FAT	3.15 Gm.	31.5 Gm.	VITAMIN D .	405 U.S.P.U.	432 U.S.P.U.
CALCIUM . . .	0.25 Gm.	1.05 Gm.	VITAMIN B_1	300 U.S.P.U.	432 U.S.P.U.
PHOSPHORUS .	0.25 Gm.	0.903 Gm.	RIBOFLAVIN .	0.25 mg.	1.28 mg.
IRON	10.5 mg.	11.9 mg.	NIACIN	4.95 mg.	7.1 mg.

*Each serving made with 8 oz. milk; based on average reported values for milk.

COOK COUNTY
GRADUATE SCHOOL OF MEDICINE

(In affiliation with COOK COUNTY HOSPITAL) Incorporated not for profit

Announces continuous courses

SURGERY—Two Weeks Intensive Course in Surgical Technique starting September 6 and 20, October 4 and 18, and every two weeks throughout the year.

MEDICINE—Two Weeks Intensive Course starting October 4. One Month Course in Electrocardiography and Heart Disease.

FRACTURES & TRAUMATIC SURGERY—Two Weeks Intensive Course starting October 18.

GYNECOLOGY—One Week Personal Course in Vaginal Approach to Pelvic Surgery starting November 1. Clinical and Diagnostic Courses.

OBSTETRICS—Two Weeks Intensive Course starting October 4.

ANESTHESIA—One Week Course in Continuous Caudal Anesthesia for Obstetrics.

OPHTHALMOLOGY—Two Weeks Intensive Course starting September 27. Course in Refraction Methods October 11.

OTOLARYNGOLOGY—Two Weeks Intensive Course starting September 13.

ROENTGENOLOGY—Courses in X-Ray Interpretation, Fluoroscopy, Deep X-ray Therapy every week.

UROLOGY—Two Weeks Course and One Month Course available every two weeks.

CYSTOSCOPY—Ten Day Practical Course every two weeks.

GENERAL, INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE, SURGERY AND THE SPECIALTIES

Teaching Faculty—Attending Staff of

COOK COUNTY HOSPITAL

Address: Registrar, **427 South Honore Street, Chicago 12, Illinois**

THE NEW YORK POLYCLINIC
MEDICAL SCHOOL AND HOSPITAL

(ORGANIZED 1881)

(The Pioneer Post-Graduate Medical Institution in America.)

For The General Surgeon

A combined surgical course comprising general surgery, traumatic surgery, abdominal surgery, gastroenterology, proctology, gynecological surgery, urological surgery. Attendance at lectures, witnessing operations, examination of patients pre-operatively and post-operatively and follow-up in the wards post-operatively. Pathology, roentgenology, physical therapy. Cadaver demonstrations in surgical anatomy, thoracic surgery, regional anesthesia. Operative surgery and operative gynecology on the cadaver.

OBSTETRICS AND GYNECOLOGY

A full time course. In Obstetrics: lectures; prenatal clinics; witnessing normal and operative deliveries; operative obstetrics (manikin). In Gynecology: lectures; touch clinics; witnessing operations; examination of patients pre-operatively; follow-up in wards post-operatively. Obstetrical and Gynecological pathology. Regional anesthesia (cadaver). Attendance at conferences in Obstetrics and Gynecology. Operative Gynecology (cadaver).

FOR INFORMATION ADDRESS

MEDICAL EXECUTIVE OFFICER, 345 West 50th Street, NEW YORK CITY

Your confidence in Lifetime Baumanometers ...pays dividends

The new
KITBAG
model
$27.50

With well over 200,000 Baumanometers in use today, it is significant that more than 90% of the 8000 hospitals in the country—as shown by our most recent survey—are equipped with one or more of these dependable instruments. Not only do these figures indicate a flattering professional preference—they present to us an all-important problem of maintenance.

The production of new Baumanometers for the Army and Navy has limited the supply available for civilian use. It is therefore imperative that the thousands of Baumanometers now serving the home front be kept in perfect condition to insure their inherent accuracy which is essential for dependable, trouble-free bloodpressure service.

Our distributors are prepared to supply genuine Baumanometer replacement parts to maintain the inherent accuracy of your instrument. Be assured that so long as there is a need for accurate bloodpressure service, there will be a Baumanometer—Standard for Bloodpressure—with accuracy, simplicity and reliability. *There will be no compromise with principle.*

Get the **FACTS** *and you will buy a Lifetime Baumanometer*

Lifetime Baumanometer
STANDARD FOR BLOODPRESSURE

W. A. BAUM CO. INC. NEW YORK
ORIGINATORS AND MAKERS OF BLOODPRESSURE APPARATUS EXCLUSIVELY

EST. 1848

1848 Haslam *1943*

QUALITY ISN'T RATIONED *in* HASLAM'S PRODUCTS

Despite all the problems of wartime production, HASLAM'S SURGICAL INSTRUMENTS are still made with the same superior craftsmanship, which, for 95 years, has made them STANDARD.

Today, naturally, all our efforts are directed towards meeting the requirements of our Armed Forces and therefore, we are unable to meet all the needs of the trade. But, some day the war will end, and then we shall again be able to supply the demands of those who have long since recognized the quality and satisfaction built into HASLAM'S INSTRUMENTS.

Fred Haslam & Co., Inc., 83 Pulaski St., Brooklyn, N.Y.

MONO-P-CHLOROPHENOL

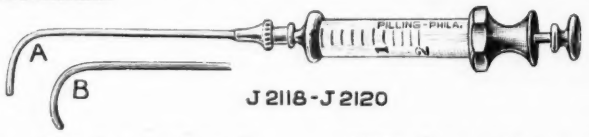
SOLUTION FOR INTRA-TRACHEAL INSTILLATION

Composed of Mono-P-Chlorophenol, Camphor and Liquid Petrolatum. At Laryngologic Clinic and in office treatment this preparation of Mono-P-Chlorophenol is used as local application to the inflamed mucous membrane in the upper and lower air passages by instillation into the larynx and trachea. It can be used both in acute and chronic laryngitis, trachitis and tracheo-bronchitis.

2 oz. bottle.....$0.80 8 oz. bottle.....$2.25

LUKENS LARYNGEAL SYRINGES

Lukens' Syringe is suitable for applying Mono-P-Chlorophenol, Gomenol, True Chaulmoogra Oil and similar medicaments.



J 2118-J 2120

J2118—Lukens syringe, 2 cc., with one silver lined cannula "A".....$4.50

J2120—Same, with two silver lined cannulae "A" and "B".....$6.50

IODINE BORIC-ACID DUSTING POWDER SULZBERGER (PILLING)

Very effective in chronic suppurative infections of the middle ear, and nasal sinuses. An intimate association of iodine and boric acid, prepared under process of Dr. Nathan Sulzberger, of New York, offering free iodine in minute division, without the necessity of breaking up a chemical compound. Made in two strengths of iodine; the strong approximately two per cent (2 %), the weak approximately one per cent (1 %). Both strengths should be available. Treatments started with the weak powder.

P 5350—1 oz. bottle 1 %.....$1.50 1 oz. bottle 2 %.....$1.50

THE GEORGE P. PILLING & SON COMPANY
Arch & Twenty-third Streets Philadelphia, Pa., U. S. A.

USE

LAVORIS

The Choice of the Well Groomed

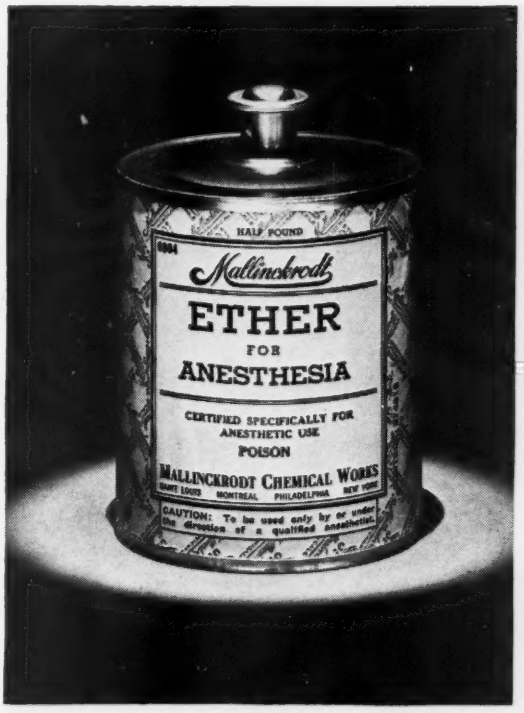
You are using the best when you use Lavoris

WHAT'S THE *first anesthetic* YOU THINK OF?

IN ALL surgery the name ETHER has come to be a synonym for anesthesia.

Much effort has been expended in the development of new anesthetics. While in some instances these newer anesthetic agents are preferable, yet most surgeons still regard ether as the anesthetic of choice in the majority of surgical cases.

MALLINCKRODT ETHER for Anesthesia is unsurpassed for purity, stability and uniform potency. MALLINCKRODT'S accumulated years of experience in ETHER production make it a choice of leading anesthetists. Supplied in ¼ lb., ½ lb., 1 lb. and 5 lb. cans.



MALLINCKRODT ETHER FOR ANESTHESIA

FINE CHEMICALS Mallinckrodt SINCE 1867

FOR VICTORY BUY UNITED STATES WAR BONDS STAMPS

MALLINCKRODT CHEMICAL WORKS

76 Years of Service to Chemical Users

St. Louis · Chicago · New York · Montreal · Philadelphia · Los Angeles

BACTERIOSTAT . . . . . CELL PROLIFERANT

SCHUYLKILL

SULFALLANTOIN

A loose addition product of Sulphanilamide and Allantoin (p-Amino Benzene Sulphonamide Glyoxyldiureide) Pat. Pending

Indicated in the Treatment of various types of infectious ulcerations and wounds; 2nd and 3rd degree burns; osteomyelitis; bursitis; compound fractures; local eye, ear, nose and throat infections, etc.

POWDER . . for dusting or making solutions or wet dressings. ¼ oz.; 1 oz. and 16 oz. in glass.

OINTMENT (2%) in a special soothing absorption base. 1 oz., 2 oz., 14 oz. and 5 lb. jars.

Literature and reprints of current papers available on request.

BE SURE to specify SULFALLANTOIN MADE ONLY BY . . . **SCHUYLKILL CHEMICAL CO.** 2346-A Sedgley Ave., Philadelphia, Pa.

Coming!

The American Journal of Surgery

Application of Sulfonamides in Fresh and Contaminated Wounds
COMDR. EMILE HOLMAN, Mare Island, Calif.

Perforating Wounds of the Intestine
THOMAS B. NOBLE, JR., Indianapolis, Ind.

Surgical Problems in the Tropics CAPT. L. K. STALKER, Rochester, N. Y.

Pentothal Sodium in Major Surgical Procedures
JULIUS D. HOLLY, Baltimore, Md.

Exteriorization Method for the Treatment of Craniocerebral Wounds
JEFFERSON BROWDER, Brooklyn, N. Y.

Perforation of the Rectosigmoid by Compressed Air
S. A. SWENSON, JR., and HENRY N. HARKINS, Detroit, Mich.

A PRACTICAL JOURNAL BUILT ON MERIT

Backed By 73 Years of Research . . .

CHAMPION

Moisture and Serum Proof

SILK SUTURES

★ Due to 73 years' continuing research, Champion Sutures rank with the finest sutures in the world today. This is attested by their widespread acceptance on all fighting fronts in the present war. In virtually all parts of the globe, Champion Sutures are aiding greatly in the rehabilitation of the Nation's wounded Soldiers, Sailors and Marines. Luckily, there will be adequate supplies of Champion Sutures available for civilian use throughout the duration.

NOTE THESE ADVANTAGES:

- ★ Free from absorption of germs.
- ★ Non-acid. Non-irritating.
- ★ Benign to tissue.
- ★ Does not adhere to skin or tissue.
- ★ Fine diameters with greater strength permit the use of smaller sizes, resulting in lessened trauma.
- ★ Maintain strength.
- ★ Withstand repeated sterilization.

★ **Made in 15 sizes—a size for every type of surgery.**

Free operating lengths will be gladly furnished on request.

GUDEBROD BROTHERS SILK CO., INC.

12 SOUTH 12TH STREET, PHILADELPHIA

Boston New York Founded 1870 Chicago Los Angeles

ANESTHESIA OF SHORT DURATION

Each Vinethene package is supplied complete with dropper-cap and folder describing technic of administration and precautions in use.

ARMY E NAVY
Buy WAR BONDS FOR VICTORY

Rapid induction, prompt, complete recovery, and infrequent nausea or vomiting make Vinethene an admirable anesthetic for home, office, or hospital use.

Literature on request

Vinyl Ether for Anesthesia Merck

VINETHENE

Reg. U.S. Pat. Off.

An Inhalation Anesthetic for Short Operative Procedures

COUNCIL ACCEPTED AMERICAN MEDICAL ASSN. ACCEPTED

MERCK & CO., Inc. *Manufacturing Chemists* RAHWAY, N. J.

Efficient Bacterial Annihilation
...the Goal of Antisepsis

Efficient bacterial annihilation, the goal of antisepsis, calls for a wide range of action. Mercresin* combines in its formula the striking germicidal power of a mixture of cresols and the bacteriostatic activity of an organic mercurial to deal a double blow, antiseptically, against the great variety of organisms commonly encountered in operating room and office practice.

This wide range of double action is coupled with speed so that Mercresin (undiluted, as used preoperatively) has a quick germicidal effect against staphylococcus aureus, is highly effective against diphtheroids, streptococcus hemolyticus and viridans, and even against the resistant molds. Mercresin is also favored because of its penetrability, its minimal irritation of tissue and its action in the presence of serum, fatty materials, or epithelial debris.

Tincture Mercresin and Tincture Mercresin (Stainless) are available in 4 ounce, pint, and gallon bottles. * Reg. U. S. Pat. Off.

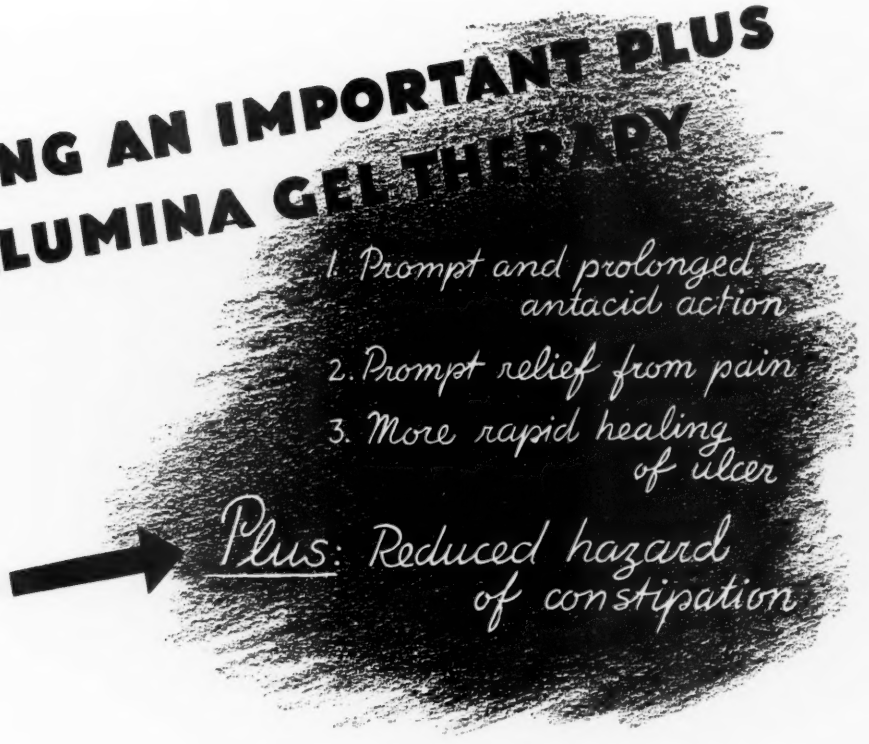
MERCRESIN

Secondary-amyltricresols	1/10%
Orthohydroxyphenylmercuric Chloride	1/10%
Acetone	10%
Alcohol	50%

Upjohn
KALAMAZOO, MICHIGAN

ANOTHER WAY TO SAVE LIVES . . . . BUY WAR BONDS FOR VICTORY

ADDING AN IMPORTANT PLUS TO ALUMINA GEL THERAPY


1. Prompt and prolonged antacid action
2. Prompt relief from pain
3. More rapid healing of ulcer
Plus: Reduced hazard of constipation

It's the "plus," the "beyond the ordinary," that counts heavily in any medicament, for upon it may depend the difference between partial and adequate success of treatment.

We believe that Gelusil has brought such a "plus" to the alumina gel treatment of peptic ulcer, because the alumina hydroxide of Gelusil is *non-reactive* and therefore does not form astringent chloride with the hydrochloric acid of the stomach. This quality effectively reduces the hazard of constipation usually associated with alumina gel treatment.

Further, there is prompt, *more sustained antacid action* afforded by the combination with magnesium trisilicate. And any calcium and phosphorous robbing tendency is compensated for in the make-up of Gelusil.

A request on your letterhead, addressed to our Professional Service Department, will promptly bring a liberal trial quantity. Gelusil is available in bottles of 6 and 12 ounces; also in tablet form in boxes of 50 and 100.

GELUSIL

THE SYMBOL OF PHARMACEUTICAL EXCELLENCE
OMNIS ORBIS
WARNER
ESTABLISHED 1856

WILLIAM R. WARNER & COMPANY, INC.
113 West 18th Street - - New York, N. Y.

RIB-BACK BLADES

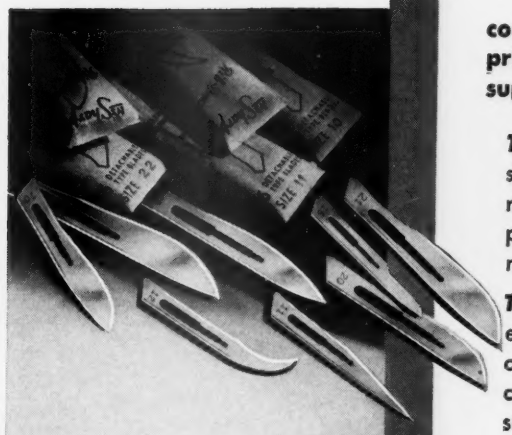
continue to be offered at the lowest price consistent with their distinctive, superior qualities

To the surgeon they mean superior sharpness with uniformity . . . adequate rigidity . . . greater strength . . . longer periods of cutting efficiency . . . virtually no interruptions due to rejects.

To the hospital buyer they mean economy in the maintenance of blade consumption at a practical minimum . . . closer budget control . . . a satisfied surgical staff.

Your dealer can supply you

BARD-PARKER COMPANY, INC.
DANBURY CONNECTICUT



It's Sharp

B-P

A BARD-PARKER PRODUCT

ACCEPTED AMERICAN MEDICAL ASSN

Zephiran CHLORIDE

Trade Mark Reg. U. S. Pat. Off. Brand of Benzyl-Trialkonium Chloride

HIGH GERMICIDAL POTENCY

LOW TISSUE TOXICITY

Plus Properties of Zephiran CHLORIDE

- DETERGENT PROPERTIES
- A WETTING AGENT
- HIGH TISSUE TOLERANCE
- PENETRATION ABILITY
- RAPID ACTION
- EMOLLIENT EFFECT
- WIDE APPLICATION
- ECONOMY

A HIGHLY potent germicide with a low toxicity index is realized in ZEPHIRAN CHLORIDE, cationic detergent and germicide; a mixture of high molecular alkyl-dimethyl-benzyl-ammonium chlorides.

In an evaluation of germicides for clinical use by Hirsch and Novak* using the phagocytosis inhibiting technic for determining toxicity, Zephiran Chloride was found to be germicidal in a 1:3970 concentration sterilizing infected blood completely whereas the phagocytosis inhibiting concentration was shown to be 1:3370. The toxicity index of Zephiran Chloride thus is 0.85 as against an average of 5.2 for 70% and 95% alcohol, and 900 for tincture of green soap.

Zephiran CHLORIDE . . . Germicide for Surgery, Obstetrics and Gynecology, Urology, Dermatology, Eye, Ear, Nose and Throat, Sterile Storage of Instruments.

*Hirsch, M. M., and Novak, M. V.: Evaluation of Germicides with Relation to Tissue Toxicity, Proc. Soc. Exper. Biol. and Med., June, 1942.

WINTHROP CHEMICAL COMPANY, INC.

Pharmaceuticals of merit for the physician

NEW YORK, N. Y. WINDSOR, ONT.

THE *Luck* BONE SAW

ECONOMIZES TIME IN ORTHOPEDIC SURGERY

The necessity for strict economy of time, due to personnel depletion, is something every civilian surgeon recognizes today. The Luck motor-driven bone drill and saw has proved clinically that it helps to save time and labor.

There are two exclusive features. The complete motor unit and cord can be sterilized in autoclave. And the motor provides a high speed of 13,000 R. P. M. at the small end, while gearing reduces speed, 6 to 1, at the other end, to which the Jacobs Chuck is attached.

The high speed makes possible the use of very small diameter slotting burrs. The lower speed is ideal for inserting Steinman Pins and Kirschner Wires as well as sawing the bone. Variable speed is obtained by a foot controlled rheostat.

Used with slotting burr in making transverse end cuts during removal of bone grafts, after longitudinal cuts have been made with circular saws.

Used with twin circular saws. They rotate up to approximately 1500 revolutions per minute. Have great power. Do not jam or burn the bone. Second blade readily removed if only single blade is desired.

◀ The Luck Bone Saw in fitted case with complete equipment.

WRITE Zimmer today for further information, or complete catalog.

Zimmer

MANUFACTURING CO., WARSAW, IND.

Made in
U. S. A.

DEKNATEL Moisture and Serum Proof SURGICAL SILK

Braided . . . Round and Uniform . . . Greater Tensile Strength

Its certain and easy manipulation . . . extra tensile strength . . . superiority where wet dressings are used . . . splinterless smooth surface . . . resistance to action of enzymes, catalyzers, lochial discharges, vaginal acids . . . soft knots and ends . . . strong smaller sizes . . . and other distinctive qualities . . . have brought it into standard practice with innumerable hospitals and surgeons.

DEKNATEL SURGICAL SILK is round and uniform throughout —ends do not unravel—is easily threaded—and its treatment impregnates every thread and coats the entire surface. It comes in 11 sizes (black or white) for the various operations.

- Non-Capillary
- Non-Oxidizing
- Non-Culture Medium
- Non-Slipping
- Non-Irritating
- Increased Tensile Strength
- Sterilizable—Repeatedly
- Easily Manipulated
- Does Not Cut Tissues
- Non-Swelling
- Samples From Each Batch Bacteriologically Tested

DEKNATEL QUEENS VILLAGE, (L. I.) NEW YORK

Buy

WAR BONDS

The American Journal of Surgery, Inc.

49 WEST FORTY-FIFTH STREET · NEW YORK, 19

...by stepping three times over a grave...

Women of a certain Moroccan tribe believe that stepping three times over a newly-made grave will prevent pregnancy.*

● In placing Ortho-Gynol on the market as a prescription product, the manufacturers have continually borne in mind that this preparation must be scientifically compounded, meticulously controlled through laboratory surveillance, and that its properties must share the same high degree of uniformity required for all acceptable medicinal preparations. Thus, though Ortho-Gynol comes in contact solely with the vaginal mucosa, its manufacturers have applied all serious effort to insure the physician of absolute safety in its continued use, as well as maximum possible effectiveness.

*Himes, *Medical History of Contraception*

ortho-gynol
VAGINAL JELLY

COPYRIGHT 1943, ORTHO PRODUCTS, INC., LINDEN, N. J.

The American Journal of Surgery

ADVERTISERS INDEX

Instruments and Apparatus

Austenal Laboratories, Inc.	August
W. A. Baum Co. Inc.	29
Becton, Dickinson & Co.	August
Crescent Surgical Sales Co., Inc.	August
General Electric X-ray Corp.	20
Fred Haslam & Co., Inc.	29
Geo. P. Pilling & Son Co.	30
Singer Sewing Machine Company	August
J. Sklar Manufacturing Co.	23
The Tower Co., Inc.	22
Edward Weck & Co., Inc.	7
Zimmer Manufacturing Co.	39

Sutures

Davis & Geck, Inc.	*Insert Facing 2nd Cover*
J. A. Deknatel & Son, Inc.	40
Gudebrod Bros. Silk Co., Inc.	33
Johnson & Johnson	*Insert Facing First Reading*

Pharmaceuticals

Abbott Laboratories	6
American Hospital Supply Corp.	August
Arlington Chemical Co.	11
The Armour Laboratories	*Insert Facing Page 16*
Ernst Bischoff Co., Inc.	August
Cheplin Biological Laboratories, Inc.	August
Ciba Pharmaceutical Products, Inc.	*4th Cover*
Cutter Laboratories	25
E. Fougera & Co., Inc.	August
Hoffmann-La Roche, Inc.	5
The Lavoris Company	30
Lederle Laboratories, Inc.	19
Thos. Leeming & Co., Inc.	August
Eli Lilly and Company	21
The S. E. Massengill Company	15
Merck & Co., Inc.	34
The Wm. S. Merrell Company	August
McNeil Laboratories, Inc.	August
National Drug Co.	August
Ortho Products, Inc.	42
Parke, Davis & Co.	13
Petrogalar Laboratories, Inc.	26
Rare Chemicals, Inc.	17
Schering & Glatz, Inc.	10
Schering Corporation	16
Schuylkill Chemical Co.	32
E. R. Squibb & Sons	12
Frederick Stearns & Company	24
The Upjohn Co.	35
Wallace & Tiernan Products, Inc.	14
William R. Warner & Co., Inc.	36
White Laboratories, Inc.	9
Winthrop Chemical Co., Inc.	2, 38
John Wyeth & Brother, Inc.	8

Hospital Supplies

Bard-Parker Co., Inc.	37
W. A. Baum Co. Inc.	29
Becton, Dickinson & Co.	August
Crescent Surgical Sales Co., Inc.	August
Cutter Laboratories	25
General Electric X-ray Corp.	20
Fred Haslam & Co., Inc.	29
Macalaster Bicknell Company	18
Mallinckrodt Chemical Works	31
Massillon Rubber Co.	August
J. Sklar Manufacturing Co.	23
The Tower Co., Inc.	22
Edward Weck & Co., Inc.	7

Post-Graduate Instruction

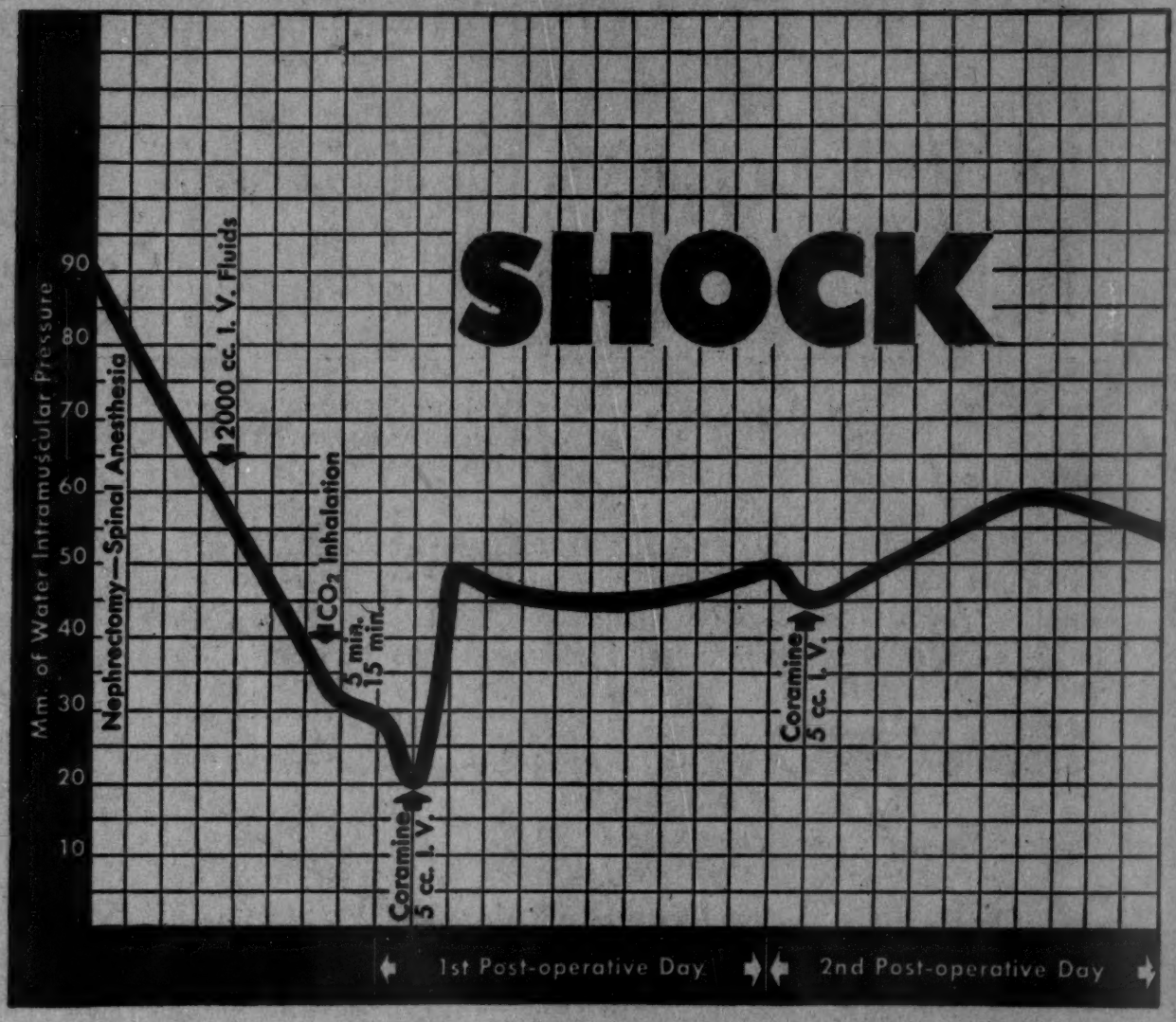
Cook County Grad. Sch. of Med.	28
N. Y. Polyclinic Med. School	28

Foods

Cereal Institute Inc.	August
The Wander Company	27

Medical Books

The American Journal of Surgery	32
D. Appleton-Century Co., Inc.	1



SHOCK is a complex syndrome having many causes and presenting many symptoms. Recent research[1] has demonstrated that in post-operative and post-anesthetic shock *intramuscular pressure drops before venous pressure fails.* This intramuscular pressure is of greatest importance in maintaining peripheral circulation and venous pressure is returned to normal by a restoration of intramuscular pressure.

CORAMINE,* of all the drugs tested, was found to promptly and spectacularly increase intramuscular pressure to normal. It was used intravenously in doses of 5-10 cc.

[1]Gunther, Lewis, Engelberg, Hyman and Strauss, Ludwig., INTRAMUSCULAR PRESSURE, Am. J. Med. Sci., 204, 265-283, Aug., 1942.

CORAMINE

COMBATS SHOCK

AMPULS **LIQUID**

*Trade-Mark Reg. U. S. Pat. Off.

CIBA *Pharmaceutical Products, Inc.*

SUMMIT, NEW JERSEY